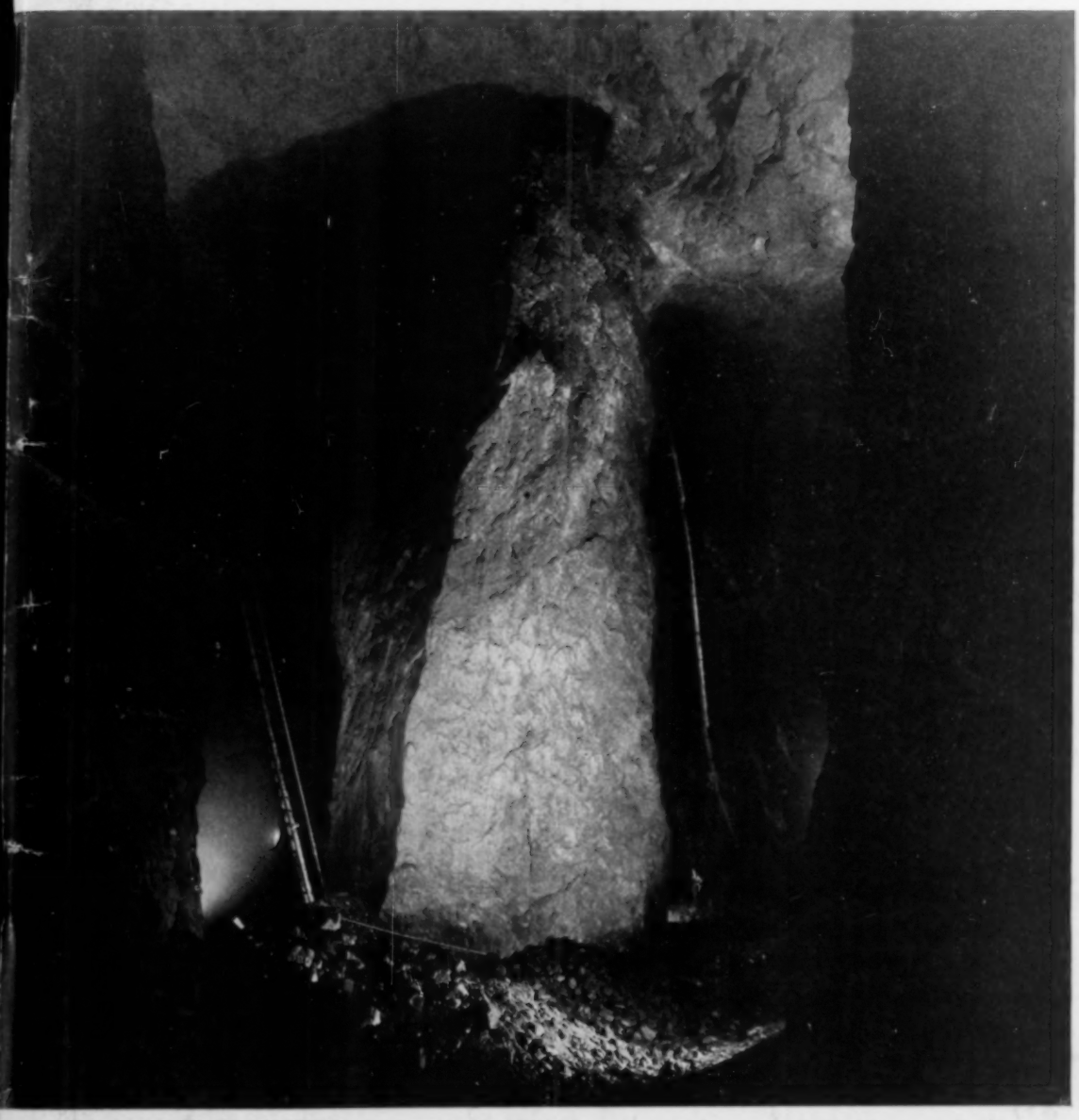
Compressed Air Magazine

OCTOBER 1944



PILLAR REMOVAL IN AN OLD MINE

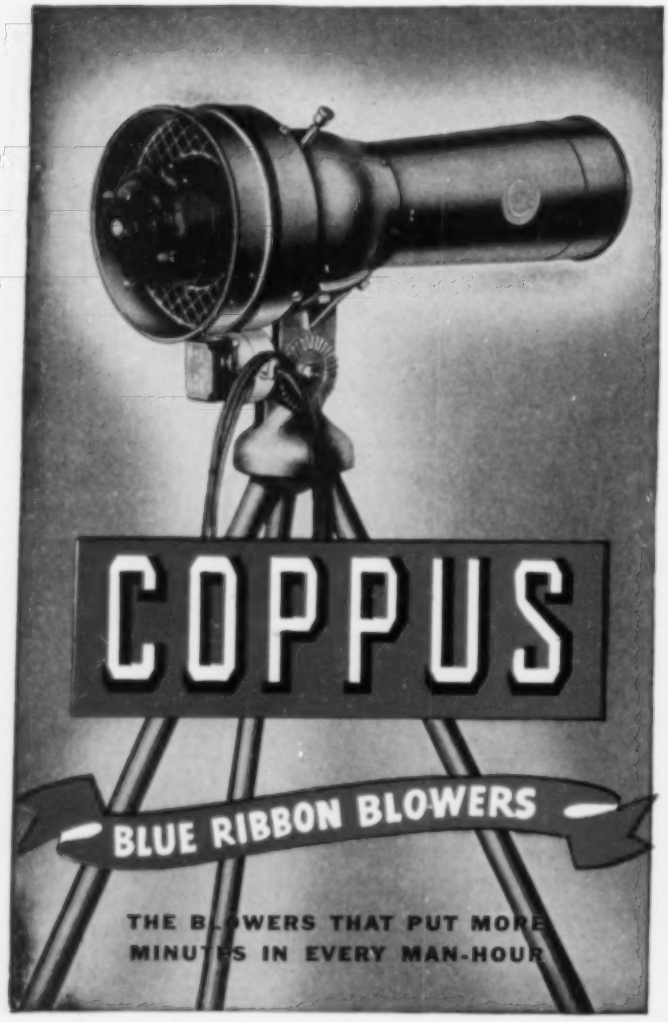
Making ready to blast down huge underground columns of iron ore.

VOLUME 49 • NUMBER 10

NEW YORK • LONDON

New Strength through Air

WORKERS HAVE MORE WAR PRODUCTION "DRIVE" WITH A COPPUS BLOWER OR HEAT KILLER NEARBY



Thousands of cases prove that a man can do more work where it's cool and comfortable than where heat and bad air are continually sapping his energy.

In these cases, Coppus "Blue Ribbon" Blowers and Exhausters have earned their salt, bringing renewed energy, skill and morale to men working near furnaces . . . in tanks . . . in underground cable manholes . . . around hot processes.

Portable, adaptable for special purposes, each one built with Coppus "Blue Ribbon" precision and strength, they are putting more working minutes into every war-essential man-hour—more and better production every day!

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 560 Park Avenue, Worcester, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets; etc., after treated with coating material.

NAME .....

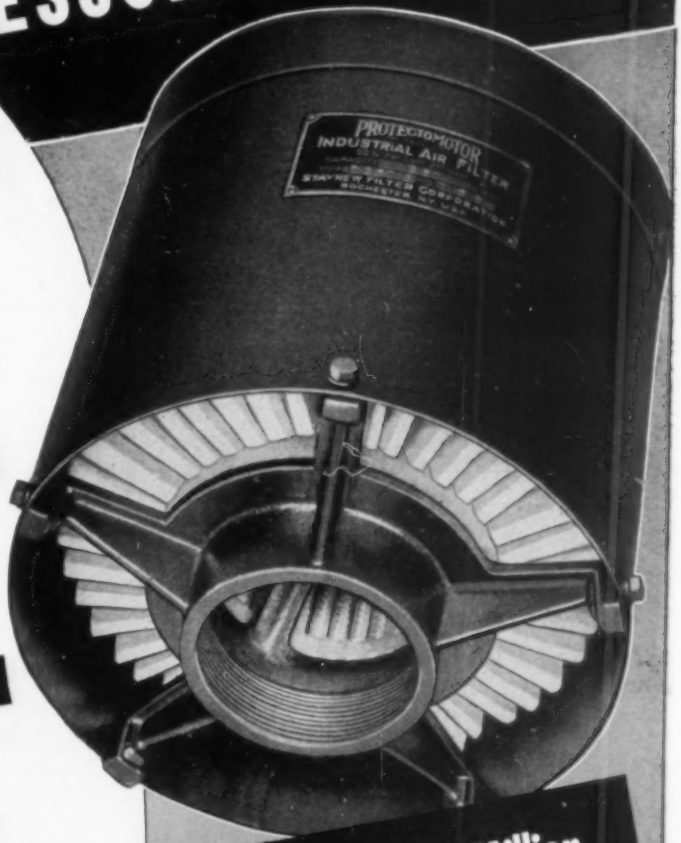
COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)

WHY PROTECTOMOTOR INTAKE FILTERS ARE BEST FOR AIR COMPRESSOR USE



★ HIGH EFFICIENCY WHEN INSTALLED

Protectomotor Air Filters for internal combustion engines and compressors feature dry-type filtering media. These media are selected to fit particular installation conditions. They have been scientifically tested in the laboratory and proven by field use. Used in combination with the patented Radial Fin Insert Construction, they provide highest operating efficiency.

★ INCREASED EFFICIENCY WITH USE

Protectomotor filtering efficiency actually *increases* when dust begins to accumulate on the surface of the media, since this forms a precoating or filter-aid of the very material which is being handled.

★ LOW RESTRICTION TO AIR FLOW

Protectomotors at maximum ratings offer initial resistance to air flow of less than ½" of water. Since the exclusive Radial Fin Construction provides a maximum of filtering area, this resistance is held to a minimum throughout the life of the filter.

★ SERVICING SELDOM NECESSARY

The Protectomotor is a masterpiece of simple, rugged construction. There are no moving parts, no reservoirs, no liquids. The extremely large active filtering area reduces cleaning to an absolute minimum for any given set of conditions. When required, cleaning is quickly and easily accomplished by vacuum, compressed air, or washing.

★ POSITIVE PROTECTION ★ ★ ★

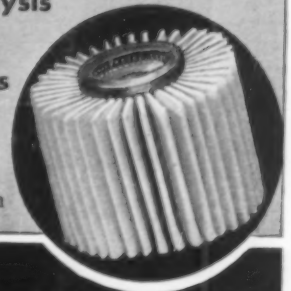
Inherent characteristics of the dry-type filtering media provide *positive* protection. Performance is *not* dependent upon periodic renewal of viscous coatings or other filter aids. Ideal for dust storm areas.

★ EFFICIENT AT HIGH OR LOW TEMPERATURES

As the filtering media used are of the dry-type, peak efficiency is maintained under all atmospheric conditions. There is no oil to evaporate at high temperatures or to congeal at low temperatures.

More than Half a Million Installations on Internal Combustion Engines and Compressors since 1920

Write for Catalog and Data Blank for Free Analysis of your Requirements



Radial Fin Construction

STAYNEW for PROTECTOMOTOR FILTERS

DOLLINGER CORPORATION
(Formerly Staynew Filter Corp.)
1 Centre Pk., Rochester 4, N. Y.

JACKBITS
Lower Drilling Costs

1. The wide range of Jackbit designs and sizes permits the use of small starters and minimum gauge changes. This greatly increases drilling speed. On one large tunnel job, when Jackbits were put to work, the drilling time dropped from 16.4 to 13.5 minutes per foot of heading advanced.

2. Jackbits result in the use of sharp bits a greater percentage of time. Rock drill upkeep costs are thereby reduced.

3. Air consumption per foot of hole drilled is less.

4. The cost of drill steel transportation is practically eliminated.

5. Jackbits reduce the amount of drill steel purchased annually.

6. Reconditioning is easy and costs are low.

The *Jackbit Line* is complete. You can resharpen your Jackbits on an I-R Grinder or Hotmill. You can heat-treat them in I-R Furnaces. You can forge Jackrod threads and shanks in I-R Sharpeners. You can easily and quickly convert your engine lathes for the complete Jackrod threading operation with the new Box Tool and adjustable Die Head.

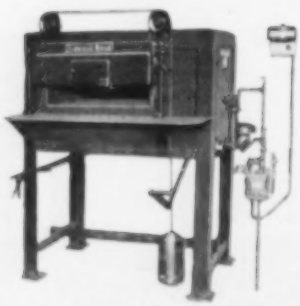
The experiences of contractors, mining men and quarry operators the world over show that the savings gained from the use of Jackbits range from 10 to 40%.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

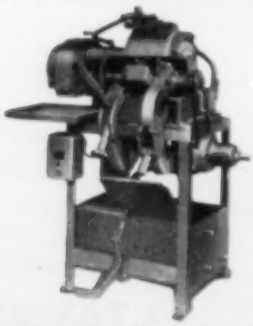
15-502

JACKBITS ARE BACKED BY A COMPLETE LINE OF RECONDITIONING EQUIPMENT



The JF Jack Furnace is a rapid-heating oil furnace designed for servicing Jackbits.

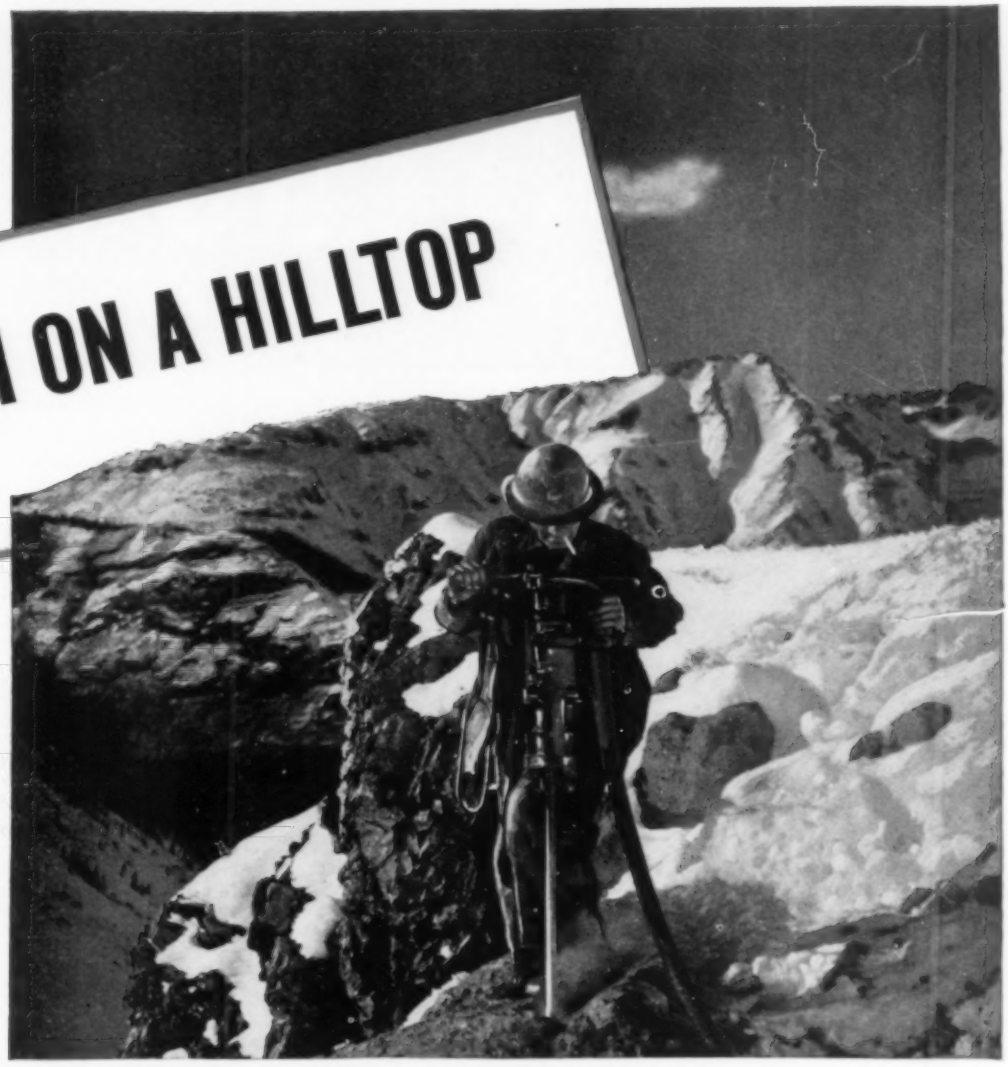
Four sizes of drill steel sharpeners permit the right selection for any job of shanking or threading, etc.



The J3 Jackbit grinder will regrind 35 hardened or 50 annealed bits per hour.

The JMA Jackmill is a high-production hotmill that handles 200 or more Jackbits per hour.

HIGH ON A HILLTOP



FROM jackhammers on mountain tops . . . to stopers in mines . . . through a thousand-and-one-jobs between . . . industry is using compressed air in an ever-increasing number of ways.

Whatever the job for "air power", efficient, trouble-free compressor operation is essential. To secure it, experienced compressor operators lubricate with Texaco.

Texaco Alcaid, Algol or *Ursa Oils* assure wide-opening, tight-closing valves, free piston rings, open ports, clear lines, continuous air supply. Their use in air compressors is nationwide. They also assure maximum service life between overhauls, fewer repairs and replacements.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

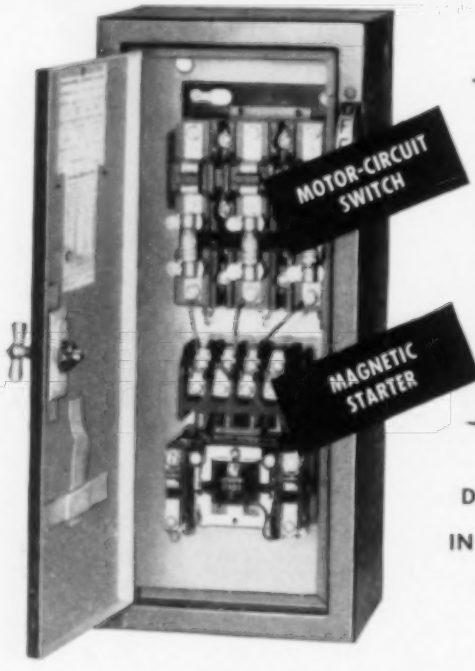
TEXACO

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

MOTOR STARTERS EVERY TYPE, EVERY KIND, FOR EVERY MACHINE APPLICATION



COMBINATION STARTERS

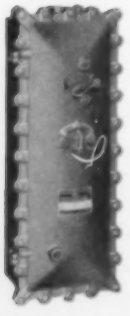
DEPENDABLE . . . ATTRACTIVE IN APPEARANCE . . . DESIGNED TO BLEND WITH MODERN MACHINES

Advantages of Combination Starters

1. ***50% reduction in mounting time***—You mount only one device, not two.
2. ***40% reduction in wiring time***—Connect to only 9 terminals, not 15. The switch and starter come connected.
3. ***Sure safety***—Cover cannot be opened while power is on the starter.
4. ***Reliable motor protection***—Protection devices co-ordinated at factory.
5. ***Saving of wall space***—The one device takes less space than two.
6. ***Improved plant appearance***—Single, streamlined case; less open wiring and conduit.

Whatever your plant's operating condition, you can get a suitable G-E combination control. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.

Write today for more information about these combination starters. Our engineers will be glad to help you select just the right starter for your application. *General Electric Company, Schenectady 5, N. Y.*

GENERAL PURPOSE	CORROSION RESISTANT	DUST-TIGHT	FOR HAZARDOUS LOCATIONS	WATER-TIGHT
				
Suitable for general-purpose indoor applications where atmospheric conditions are normal.	Made for corrosive atmospheres and hazardous locations. All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.	For use in steel mills, cement mills, and other locations where the dust content of the atmosphere is heavy.	Designed to withstand internal explosions. The flanges, which are securely bolted on all sides, are ground to tolerances which will not permit the escape of gases.	Suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks.

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

80 000 lbs.

ON 8 FULL FLOATING WHEELS

The ceiling on payloads has been raised by Model TR-15T-EASTON's latest development. It is built for hauling heavy material loaded by large shovels in pit and quarry.

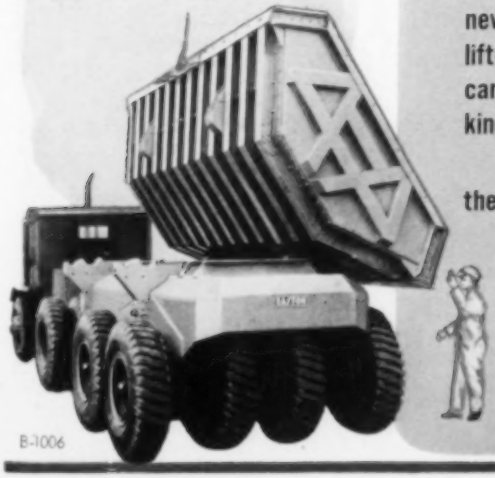
The unique wheel arrangement provides an air brake for each wheel and full-floating, spring-suspension for each dual pair. For the first time, it is now possible to build a semi-trailer of tonnage capacity limited only by the power of the tractor itself.

EASTON engineers have extended the use and application of this new full-floating wheel development to semi-trailers equipped with lift-gate or automatic down-folding door bodies. Quarries and mines can make profitable use of these large tonnage units for handling all kinds of material.

Let us have your haulage problem now! Perhaps we can give you the early delivery you want.

Write to engineering Counsel, Easton Car & Construction Company, Easton, Pa.

The TR-15T is dumped by overhead hoist. Other body models employ hydraulic hoists for discharging their 40-ton loads.



B-1006

EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS

Eimco's
Model 40 RockerShovel

The Machine for Your Post-War Planning

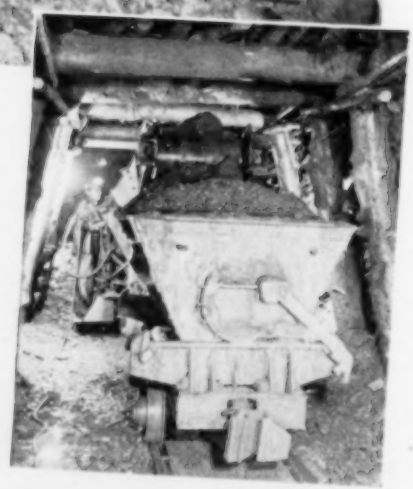
Years of war and destruction must be followed by peace and reconstruction. Water-tunnel projects, mine development to replace exhausted natural resources, subways and underground shelters, whatever private enterprise or government may plan along this line the Eimco Model 40 RockerShovel can play an important part—no job too big—a giant for capacity work at a minimum of upkeep.

Eimco's three RockerShovels, Models 12, 21 and 40 are designed to cover the entire field of underground loading. Consult an Eimco engineer or write for literature.

A 75

Specifications

Model 40 RockerShovel. Air or electric motor driven. Powered swing. 12 cubic foot bucket. Loads at the rate of 3 to 5 tons per minute. Weight 14,700. Track gauge 30" to standard railroad.



EIMCO

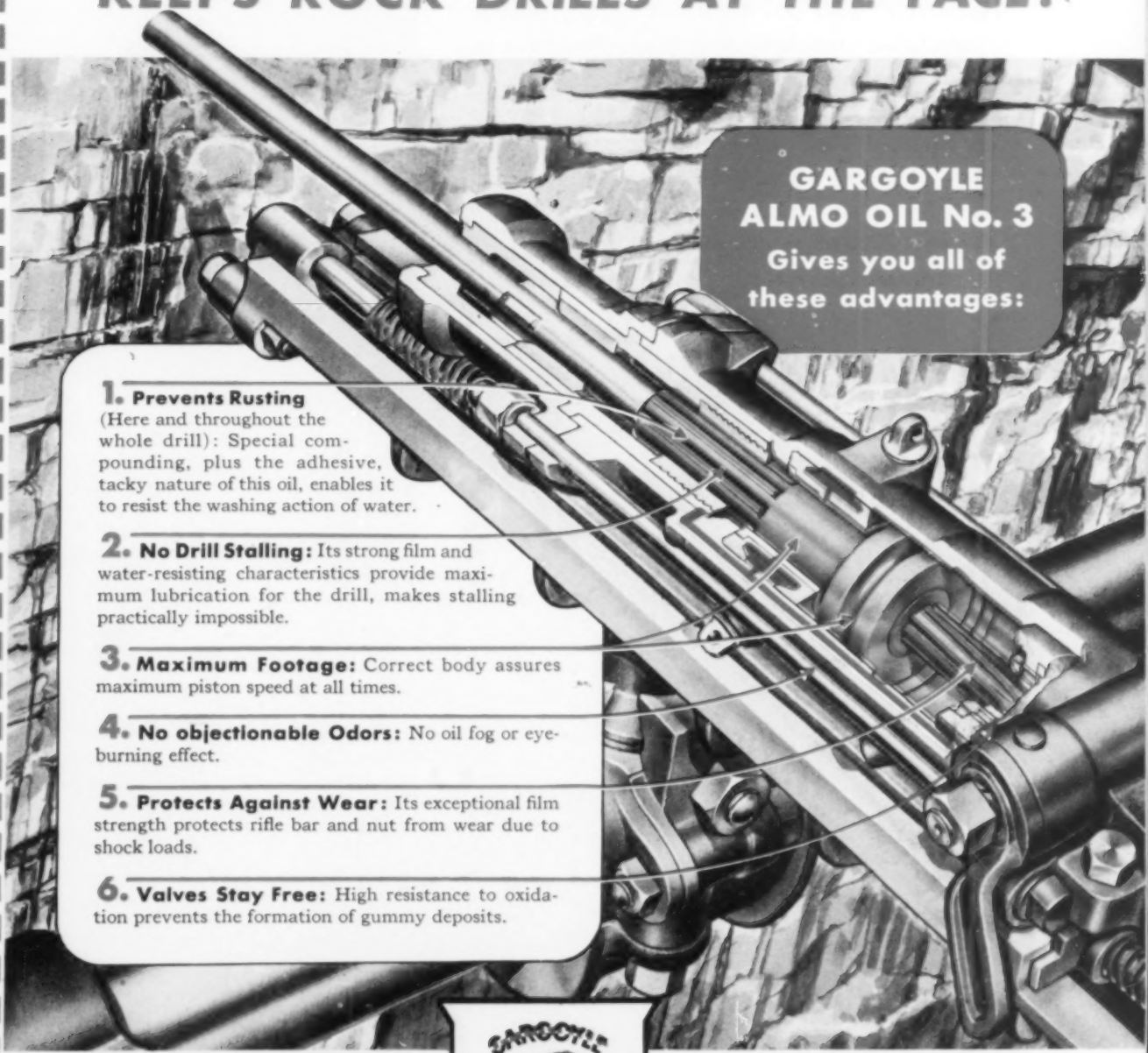
THE EIMCO CORPORATION

Executive Offices and Factories Salt Lake City 8, Utah
Branches: New York, Chicago, El Paso, Sacramento, St. Louis

HOW TO SOLVE OPERATING PROBLEMS WITH *Correct Lubrication*

Special Protection Against Shock Loads and Water

KEEPS ROCK DRILLS AT THE FACE!



GARGOYLE ALMO OIL No. 3
Gives you all of these advantages:

1. **Prevents Rusting** (Here and throughout the whole drill): Special compounding, plus the adhesive, tacky nature of this oil, enables it to resist the washing action of water.

2. **No Drill Stalling:** Its strong film and water-resisting characteristics provide maximum lubrication for the drill, makes stalling practically impossible.

3. **Maximum Footage:** Correct body assures maximum piston speed at all times.

4. **No objectionable Odors:** No oil fog or eye-burning effect.

5. **Protects Against Wear:** Its exceptional film strength protects rifle bar and nut from wear due to shock loads.

6. **Valves Stay Free:** High resistance to oxidation prevents the formation of gummy deposits.

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

SOCONY-VACUUM OIL CO., INC.

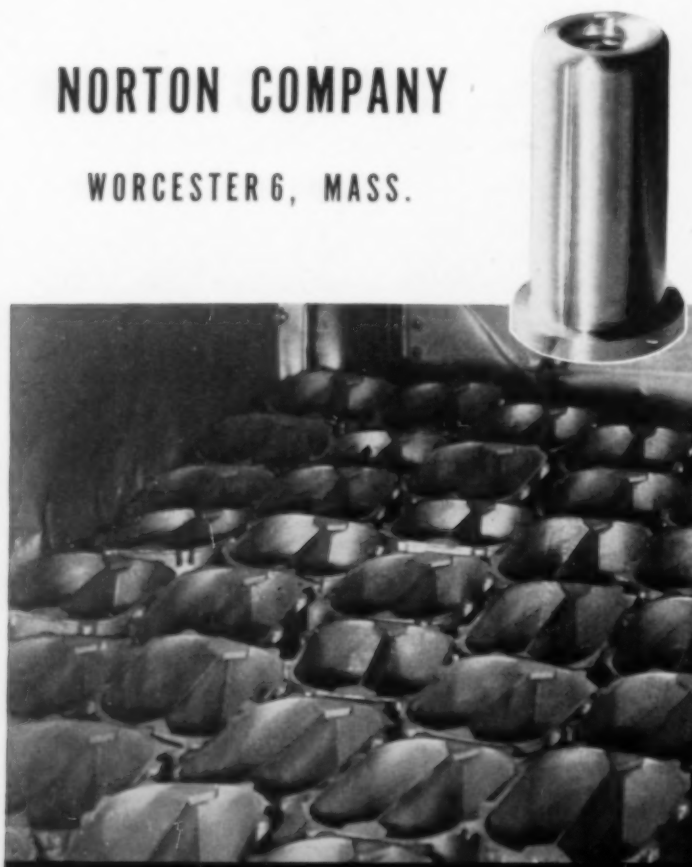
GARGOYLE
Lubricants

Standard Oil of N.Y. Div. · White Star Div.
Lubrite Div. · Chicago Div. · White Eagle Div.
Wadhams Div. · Magnolia Petroleum Co.
General Petroleum Corp. of California.

CALL IN SOCONY-VACUUM

NORBIDE* NOZZLES Last Longer

NORBIDE Nozzles for pressure blasting last longer—100 times and more—because they are made of Norton Boron Carbide, the hardest material made by man. For this reason NORBIDE nozzles are extremely wear-resistant and, therefore, the opening in the nozzle remains practically constant in size for a long time. This means that the stream contour remains concentrated, abrasive velocity does not drop and air consumption is much less than with conventional types of nozzles. Frequent stops to change nozzles are banished when you use NORBIDE nozzles with their guaranteed life of 750 hours when used with sand, 1500 hours with steel shot or grit (they often give over 2200 hours with steel grit).



NORTON COMPANY

WORCESTER 6, MASS.

*Hardest Material Made by Man

On The Cover

OUR cover picture shows ladders set up to start the demolition of some of the mammoth pillars left by early-day miners to support the overlying rock in the Clonan Mine of the Republic Steel Corporation at Mineville, N. Y. These pillars range from 60 to 125 feet in height and from 25 to 50 feet in diameter. Some of them contain as much as 30,000 tons of ore each, and more than 500,000 tons of ore has been reclaimed from this area since 1941. Miners working at the tops of the ladders first drill into the pillars just below the roof and blast off about 8 feet to provide working room. Formerly, a pillar was then reduced progressively by cutting it down in 12-foot steps, using hand-held drills to put in vertical blast holes. Recently a new method of drilling a series of diamond-drill holes was adopted. These extend clear down to the base of the column and are loaded, the entire pillar being brought down with one shot.

•

In This Issue

IN NORMAL times the Sunshine Mine in Idaho produces around 10 percent of the nation's annual output of silver. During the war it has been an important source of antimony and has also contributed large amounts of lead and copper. The colorful story of its development is told by H. W. Ingalls, editor of the *Wallace* (Idaho) *Miner*.

•

LARGELY through the financial help of the Government, increased facilities have been provided for mining the magnetite iron-ore deposits along the eastern seaboard. One of the principal new developments is the Fisher Hill plant of the Republic Steel Corporation near Port Henry, N. Y. Highlights of the program carried out there are presented in the article, *Old Adirondack Mine Again Producing Iron Ore*.

•

TUNNELING technique learned in Canada's metal mines was turned to war purposes by 200 soldier-miners who spent nearly two years at Gibraltar excavating for a hospital, workshops, and fortifications within the rocky confines of the famous British stronghold. For many of the facts in our account of these operations we are indebted to the *Canadian Geographical Journal*.

•

Correction

IN THE article on *Conveying Bulk Materials with Air*, in our September issue, the statement "pressure times velocity is a constant . . " on page 224, column three, should read: "pressure times volume is a constant . . "

Compressed Air Magazine

COPYRIGHT 1944 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 49 **October, 1944** NUMBER 10

C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
A. M. HOFFMANN, *Assistant Editor* J. J. KATARBA, *Advertising Manager*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E.C.4.
F. A. MCLEAN, *Canada*, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

Sunshine—a Silver Mine that Now Yields War Metals—*H. W. Ingalls* . . 246
Compressed Air at Work 252
Old Adirondack Mine Again Producing Iron—*C. H. Vivian* 254
Tunneling at Gibraltar 260
From Smoke Signals to Morse Code—*Vincent Colby* 263
Automatic Contour Control for Machine Tools 265
Air-Line Separator Operates on New Principle 266
Hitler's Flying Bombs 267
Editorials—Rockburst Research—Vitamins from the Sea 268
Foundryman Uses "Lost Wax Process" 269
Automatic Hardness Tester and Stamper 269
Industrial Notes 270

ADVERTISING INDEX

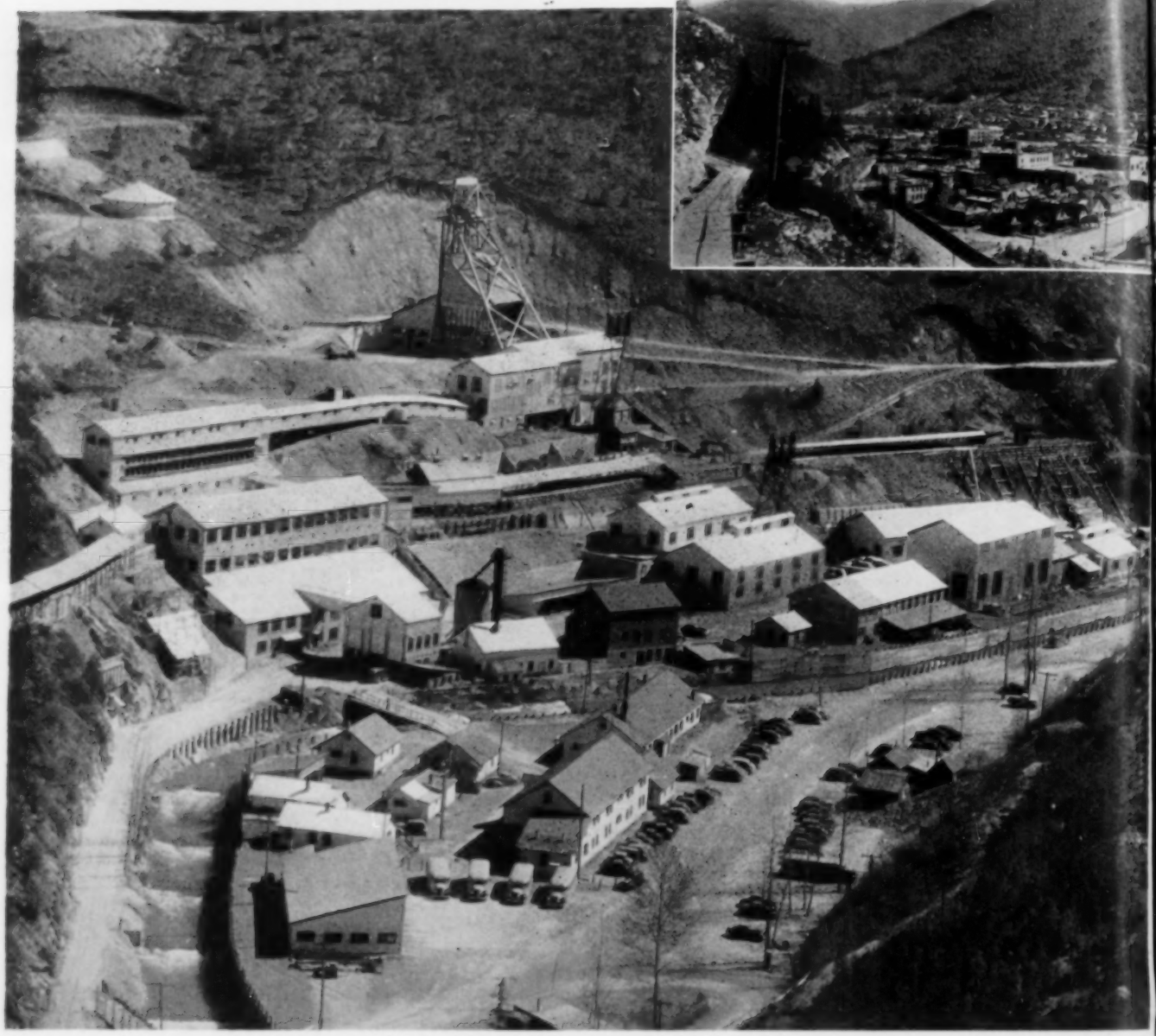
Aircraft Standard Parts Co. 41
Air-Maze Corporation 26
Allis-Chalmers 22
American Air Filter Co., Inc. 29
American Brass Company, The . . . 28
American Hoist & Derrick Co. . . . 38
Bearium Metals Corp. 35
Bethlehem Steel Co. 31
Bird-White Company 37
Blaw-Knox Company 44
Bucyrus-Erie Company 39
Burgess-Manning Company 41
Burgess-Norton Mfg. Co. 33
Carborundum Company, The 24
Conrader Co., R. 35
Cook Mfg. Co., C. Lee 21
Coppus Engineering Corp. 2nd. Cover
Crane Co. 34
Dollinger Corporation 3
Easton Car & Construction Co. . . . 7
Eimco Corporation, The 8
Garlock Packing Company, The . . 37
General Electric Company 6
Goodrich Company, The B. F. . . . 14
Graton & Knight Company 13
Hercules Powder Company 40
Industrial Clutch Co., C.M. Eason 25
Ingersoll-Rand Co. 4, 15, 32, 42, 3rd Cover
Johnson Corporation, The 33
Madison-Kipp Corporation 30
Maxim Silencer Co., The 17
Murphy & Co., Jas. A. 38
New Jersey Meter Co. 41
Niagara Blower Company 12
Nicholson & Co., W. H. 11
Norgren Co., C. A. 37
Norton Company 10
Powell Co., The Wm. 19
Shell Oil Co. 18
SKF Industries, Inc. 27
Socony-Vacuum Oil Co., Inc. 9
Square D Company 35
Texas Company, The 5
Timken Roller Bearing Co., The 4th Cover
United States Steel 20
Victaulic Company of America . . . 45
Vogt Machine Co., Henry 23
Wagner Electric Corporation 38
Walworth Co. 16
Waukesha Motor Company 36
Westinghouse Air Brake Co. 33
Westinghouse Elec. & Mfg. Co. . . . 43
Wisconsin Motor Corporation 35

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit.

Published by Compressed Air Magazine Co., G. W. MORRISON, *President*; C. H. VIVIAN, *Vice-President*; F. E. KUTZ, *Secretary-Treasurer*
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York 4, N. Y, L. H. GEYER, representative.
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents. COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index.

SUNSHINE—



THE story of the Sunshine Mine in the Coeur d'Alene mining district of Shoshone County in northern Idaho is like a chapter out of the Arabian Nights. Nevertheless, it is a true picture of the failures, disappointments, and success attending the discovery of some of the fabulous riches that Nature has hidden in the earth's crust as a reward for the venturesome prospector, miner, and capitalist who have courage and initiative and who are lucky enough to dig in the right spot.

The Sunshine Mine was found in 1884 by two bachelor prospectors, Dennis and True Blake, who at that time also took up a small ranch at the mouth of the canyon where the mining property is located. It lies between Wallace and Kellogg and just east of the famous Bunker Hill Mine which was only a prospect then but which is now the largest lead producer in the United States. The Blake brothers had no idea that they had discovered one of the biggest and richest silver deposits in the United States. Nature had hidden it well—a mile deep—and capped it with a huge mountain of rock and dirt covered with primeval forest. There were no roads or trails other than those made by their own efforts. They were possessed of only pioneer tools—picks, shovels, hand drills —and possibly a wheelbarrow; but with this meager equipment, and the optimistic hope and faith peculiar to the prospector, they started to do their exploratory work on their mineral locations, which they called the Yankee Boy. The latter included the Yankee Lode, Sherman, Cleveland, and Norcross claims, of approximately 48 acres, and the Yankee millsite covering about four acres.

For many years the brothers scratched around on these claims, digging shallow prospect holes here and there wherever they came across the small fingers of ore that had found their way to the surface. The little ore they did uncover was rich in silver, but it was in hard rock and

—a silver mine that now yields war metals

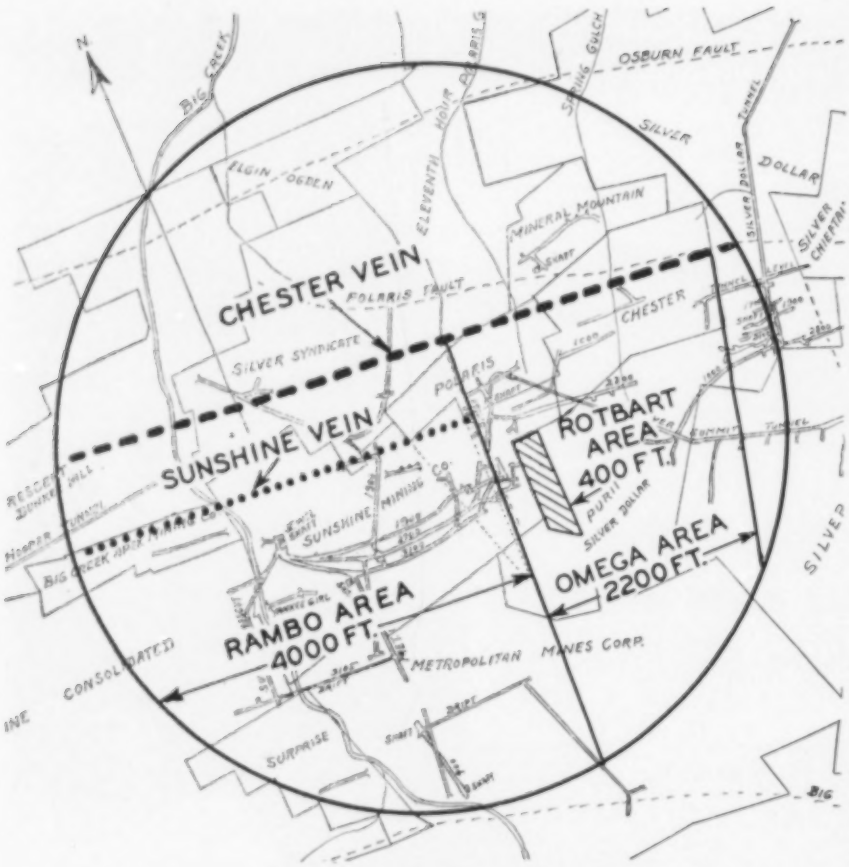
H. W. Ingalls

THE MINE AND ITS ENVIRONS

On the opposite page is a general view of the Sunshine surface plant taken before the war. The principal mill buildings are at the left. In the background is the headframe of the Jewell Shaft, which is 3100 feet deep. The dark structure in the center houses the executive offices. The picture at the top shows a section of Wallace, a town of 4000 situated a few miles from the mine. The mountains are the Coeur d'Alenes, a part of the Bitter Root Range. The old ranch of the Blake Brothers, discoverers of the Sunshine lode, is now a golf course (directly above) where mine employees can relax. The underground view (right) shows a crosscut that is used as a haulageway. Ore trains are drawn by electric locomotives, and tracks are maintained for fast transportation to shafts. There the ore is transferred to loading pockets from which the hoisting skips are filled.

laboriously mined. It had to be hand sorted to separate the good from the bad, resulting in a slow accumulation of a product that would permit shipment at that time. This ore was sacked and taken to their ranch by pack burro in summer and by go-devil in winter. There it was stored until enough to constitute a shipment had been piled up, when it was sent to Wallace, the nearest shipping point, which then boasted a narrow-gauge railroad that ran to Old Mission on the Coeur d'Alene River. From there, freight was carried by boat to Coeur d'Alene Lake and thence to Spokane and Portland.

It sometimes took the Blake Brothers more than a year to accumulate a shipment; but in the course of time they built up a small fortune and finally decided to retire, leasing the property to Sidney Shonts, a mining engineer of Wallace. Shonts put in some equipment, including a small crusher and Cornish-type hand jigs, and is reported to have made some money. He was succeeded by Dan Price, a stockbroker of Kellogg who, with associates, spent considerable money in following the vein down to water level. In doing this work they found bunches of high-grade ore and eventually ran a water-grade tunnel to the vein from a point lower down on the hill. That tunnel failed to locate the ore because the vein had faulted to the south, away from the workings, so they concluded that it had pinched out and sold their interests to E. C. Tousley, a mining stockbroker of Spokane who already owned a mining corporation that he called the "Sunshine." This corporation took over the property on a lease and bond agreement and operated it on a shoestring basis, always short of money to meet pay rolls and other expenses. During that time the company acquired the Yankee Girl group of claims southwest of the Sunshine's Yankee Boy, and this introduced into the picture J. B. Cox, one of the heavy owners of Yankee Boy.



WHERE SUNSHINE MINES FOR OTHERS

This sketch shows the surface boundary lines of Sunshine and its neighbors and indicates the different areas that have been set up where Sunshine extracts ore belonging to others and divides the proceeds under terms amicably agreed upon. The Chester and Sunshine veins dip to the south with depth.

Mr. Cox was a general merchant in Kellogg. He says he "became paymaster and resident agent, and as such had many anxious moments worrying over paydays, lawsuits, and getting in enough supplies to keep things moving." The mine was never properly financed in those days, he states. The idea was to make it pay its own way, and this they were trying to do with ore shipments from a vein that had been discovered by following the advice of a miner, named William Newton, who had been leasing in the old workings and had joined Tousley's company. The latter owed the Kellogg Hardware Company $15,000 and the First National Bank of Kellogg $9,000, besides payments due the Coeur d'Alene Hardware & Foundry Company on a hoist and other equipment.

Tousley finally selected Yakima, Wash., as a likely place to sell Sunshine stock because of the great revenue-producing fruit industry surrounding that town. He succeeded in disposing of a large block to John Sawbridge, a retired plumber and apple grower, and to other substantial residents of the Yakima Valley. The company was originally incorporated for 1,500,000 shares, and still retains that capitalization. Sawbridge knew absolutely nothing about the mining business, and men familiar with the Coeur d'Alene district considered the Sunshine a wildcat. As a matter of fact, the property had been examined by numerous mining engineers and geologists, some of national reputation, all of whom turned it down. Engineers scouting for the late F. Augustus Heinze, the former copper king of Butte, told him it was too small and uncertain for his consideration.

However, none of this unfavorable reputation daunted John Sawbridge. He sold stock to everyone of his friends and acquaintances in the Yakima Valley whom he could talk into buying it. He employed Robert S. Merriam, a mining engineer of Wallace, to supervise the sinking of a shaft to a point 500 feet below that where Dan Price had lost the vein. This work proved disappointing, and Merriam was succeeded by C. C. Samuels who found increasing quantities of ore by drifting on the vein opened by Merriam. Samuels sank a winze on the vein from the 1500- to the 1900-foot level, where Mr. Cox says they "hit the jack pot" which put the Sunshine on its feet. After Samuels came Frank Eichelberger, an engineer, under whose direction the rehabilitation and expansion of the plant was begun. During recent years R. M. Hardy, a banker of Yakima, has been president of the company and R. D. Leisk general manager. Under this management the mine has made its greatest strides toward the formation of a permanent institution. In fact, the progress has been much like the steady growth of a great manufacturing enterprise.

Shortly after this country entered the war, the company faced a serious problem because of the government order limiting so-called "silver mines" to certain priorities in operating supplies, construction materials, and manpower allocation. Sunshine was not exclusively a silver mine. In addition to silver, it provided substantial quantities of copper and antimony as by-products, as well as a very small amount of lead. The concentrated product was treated at a lead smelter, which did not pay for the lead content. The copper in the ore was recovered at the smelter, subject to a heavy deduction in price, while the antimony was not only a total loss but resulted in smelter penalties.

Antimony was one of the strategic metals listed by the War Production Board, and because of its scarcity Sunshine metallurgists began experimenting with that element. After months of work the chief metallurgist, Church Holmes, developed a leaching and electrolytic process whereby the antimonial content of the ore was successfully and economically recovered in laboratory tests and later in a pilot plant. The next thing was to build a commercial plant. The difficulties were great. Priorities for structural steel and electrical equipment were hard to get, and large quantities of both were required. Company scouts on the lookout finally located a bridge in Washington that government engineers were scrapping to make way for the Grand Coulee Dam backwater. Sunshine bought enough of the steel to form the framework for the antimony plant. The busy scouts then discovered a lot of electrical equipment, including a direct-current generating unit and copper bus bars, which the Spokane electric street railway had discarded when it abandoned streetcars for bus lines. This was purchased and used in the construction of the antimony plant, which soon began to turn out high-grade cathode antimony ready for the market.

Much of Sunshine's success is attributable to the fact that it has always been ready and willing to help neighboring mining companies develop their properties through its deep workings, not only doing the work for them on a contract basis but sometimes also furnishing the money to do it. This system of mutual understanding and aid has resulted in great benefits both to Sunshine and to other mines.

The first experience along this line was with the Polaris Mining Company.

Its property, adjoining Sunshine on the east, was located by the late U. S. Senator William B. Heyburn who, with associates, shipped some rich silver ore and finally began to sink a shaft on the Polaris vein near the Yankee Boy east-end line. They were stopped by the Blake brothers, and disputes subsequently arose over extralateral rights to ore bodies in this area where the claims came in conflict. Rather than engage in an expensive lawsuit, they compromised by blocking out about twenty acres of territory which they called the "intervening area" and which the miners quickly dubbed No Man's Land. There the companies agreed to divide the field of operations, Polaris mining above the 1700-foot level and giving 40 percent of the profits to Sunshine, and Sunshine working below the 1700 and giving 40 percent of the profits to Polaris.

All of Sunshine's production has come from the Yankee Boy. The south vein, a parallel fissure about 1200 feet farther south, was never even prospected. A few years ago, Sunshine offered to pay half the cost of a diamond-drill hole to be put down from its 3100-foot level as a last resort in a long search for ore in the Sunshine Consolidated property, which adjoins Sunshine on the west. This hole indicated the presence of ore in the south vein, and Sunshine volunteered to open it with a crosscut from the 3100 level. This crosscut was driven, and work was continued on the vein for a considerable distance in Sunshine Consolidated ground with very promising results. Sunshine then purchased a 50 percent interest in Sunshine Consolidated ores and agreed to operate the property as soon as manpower was available.

Encouraged by this find, Sunshine drove a crosscut from the 3100 level to prospect ground owned by the Metropolitan Mining Company lying south of Sunshine. This also cut the south vein, but this time in Metropolitan's area and 1500 feet east of the Sunshine Consolidated opening, the two crosscuts forming a huge Y. The part of the vein between the two crosscuts has been developed by drifting for 1500 feet and shows commercial ore for more than half that length.

During these years the Polaris Mining Company, to which reference has been made, had passed through many ups and downs until the late James F. McCarthy bought a controlling stock interest in it for the Hecla Mining Company, of which he was then president and manager. He induced the Newmont Mining Company to join the organization through the purchase of stock and spent $800,000 in development work—sinking a shaft to a depth of 1000 feet, driving an outlet tunnel a distance of more than a mile, and building a mill before he ever produced a pound of ore. Later, although the investment was returned, production from the mine proved disappointing. Polaris acquired a controlling interest in an adjoining group, called the Chester, and extensively prospected the Chester vein down to the 1900 level, but also with disappointing results.

TYPICAL MINERS

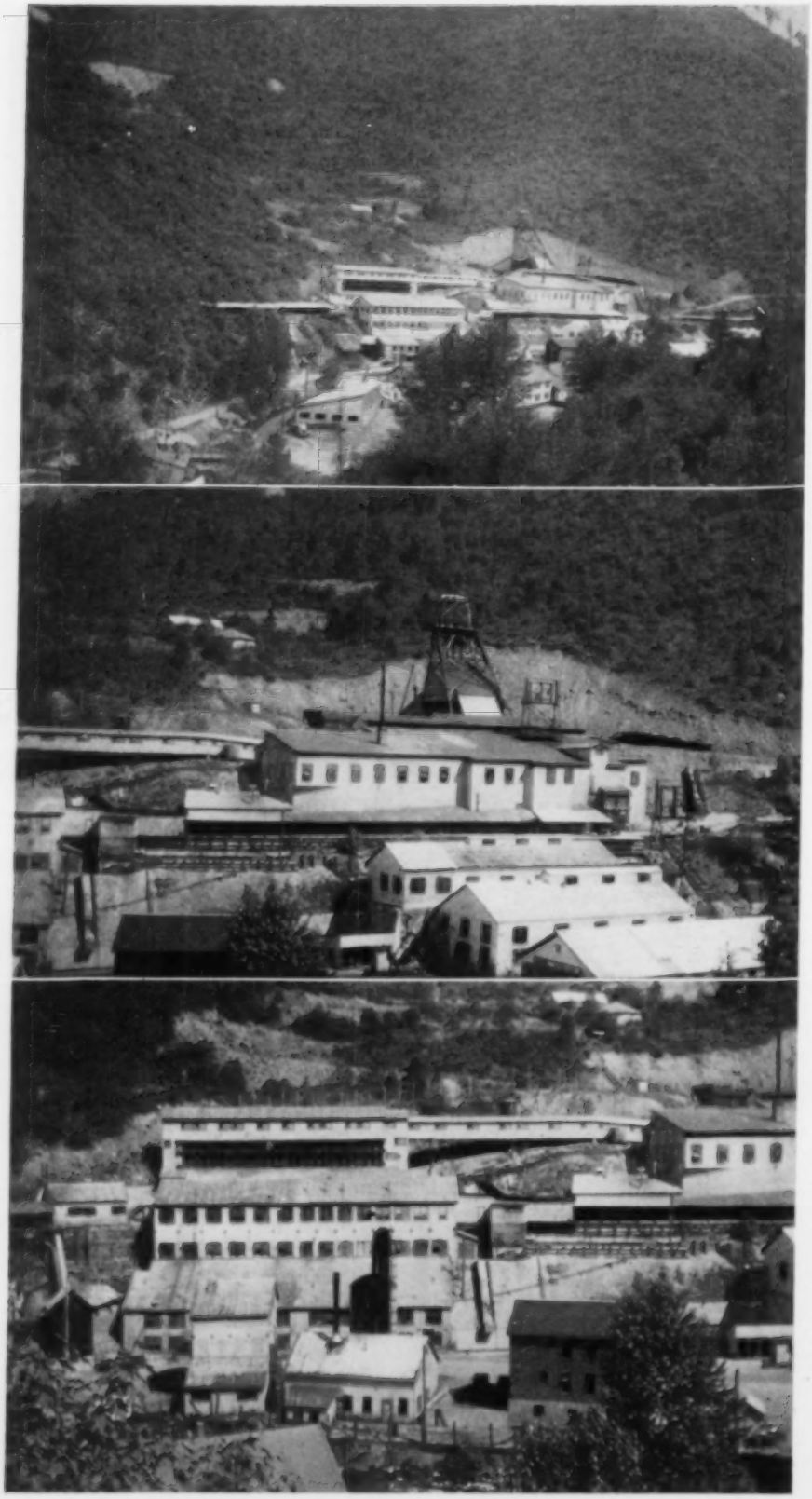
A close-up of one of the drilling faces showing two miners with a hand-cranked drifter drill mounted on a bar.

In 1943, under agreement with the Polaris Company, Sunshine was following the Polaris vein easterly by drifting on its 2700 level to get to a point 1400 feet deeper than the Polaris shaft. When this work was completed, the vein had developed insufficient quantities of ore, so L. E. Hanley, who succeeded McCarthy as president and manager of both Hecla and Polaris, proposed to take a last look at the Chester vein and requested Sunshine to drive a crosscut to it, a distance of 300 feet. Miners on the job, who were familiar with the disappointing developments in connection with the same vein on upper levels, called the crosscut "the last nail in the Chester coffin."

Much to the surprise of everybody, however, the crosscut, upon reaching the Chester vein, cut through about 10 inches of ore in a wide mineralized shear zone. Assays gave the surprising values of 74 percent lead and 147 ounces of silver per ton. In advancing eastward, the ore broadened within a short distance to the full width of the drift, and picked samples of the high-grade material assayed as high as 2800 ounces of silver and 20 percent copper, while others ran as high as 82 percent lead and more than 100 ounces of silver. All the muck taken out of the drift was shipped direct to the Bunker Hill smelter without hand sorting or mill treatment.

The ore body was followed easterly from the discovery point for a distance of 160 feet, where it entered the east end of the Rotbart claim owned by the Silver Dollar Mining Company under a leasing agreement with the Lincoln Mining Company. There the drift work was suspended by mutual agreement. Sunshine then crosscut to the vein on its 2900 and 3100 levels and found excellent ore in all openings. Next, raises were put through on the vein, connecting the levels and proving the extent of the ore shoot for a vertical distance of 600 feet. Since that time Sunshine has opened the vein on the levels easterly and westerly from the discovery point, proving continuity of the ore for a distance of 800 feet, with the full extent of the ore shoot still undetermined. In the first opening of this vein on the 3100-foot level in Silver Syndicate ground the company produced ore to the value to $51,878 in the initial 140 feet of drift work.

Discovery of this big ore body at a depth of more than a mile below the surface in a network of conflicting mining claims owned by five different companies—Sunshine, Polaris, Silver Syndicate, Silver Dollar, and Lincoln—pre-



RECENT SUNSHINE PICTURES

Comparison of the general view (top) with that shown at the beginning of the article will reveal that some buildings have been added since the war began. The center picture shows the new electrolytic-acid antimony plant which produces marketable antimony directly from the silver-copper-antimony concentrates that are made in the flotation concentrating mill at the bottom. It has a daily capacity of 1100 tons.

sented many complications and prospective lawsuits in the matter of determining ownership. Any attempt to assert sole ownership would have resulted in years of litigation and the expenditure of hundreds of thousands of dollars, with the final result uncertain. With the nation at war, the lead, silver, copper, and antimony contained in this rich ore body were badly needed, and a satisfactory settlement was ultimately worked out. It is one of the few cases in mining history involving extralateral rights with so many conflicting ownerships that has been settled without recourse to law.

Because of its deep workings and miles of tunnels on succeeding levels in close proximity to the new strike, Sunshine had the only economic approach to the ore body. Further, with its milling and metallurgical equipment, it had the facilities necessary to get immediate action and profits. Sunshine promptly made extralateral agreements with Polaris and Silver Syndicate by which two areas were set up on the Chester vein. In one of these, the Rambo, the equities to the ore are: Sunshine, 60 percent; Silver Syndicate, 40 percent. Sunshine also owns a large block of Silver Syndicate stock. In the other area, the Omega, the equities are 50 percent Sunshine and 50 percent Polaris.

Sunshine and Polaris then concluded negotiations with Silver Dollar by conceding the latter's rights as lessee of Lincoln to one-third of a 400-foot-long block of the vein in the Rotbart claim, the division to be one-third each to Sunshine, to Polaris, and to Silver Dollar, with the latter agreeing to pay the Lincoln Mining Company a 12½ percent royalty on the net smelter returns from its interest. Sunshine is to do all the mining and milling for the three other groups, who are to pay their proportion of the costs before distribution of profits. The ground has been blocked off in three sections—the Rambo, the Omega, and the Rotbart. The Rambo area extends westerly approximately 4000 feet from the Omega line; the Omega runs easterly 2200 feet from the Rambo line; and the Rotbart is confined to the Rotbart claim within the Omega section. All mining men and engineers of the district pronounce this the greatest discovery of high-grade lead and silver ore that has been found in the Coeur d'Alene, or perhaps in the entire United States, during the past 30 years.

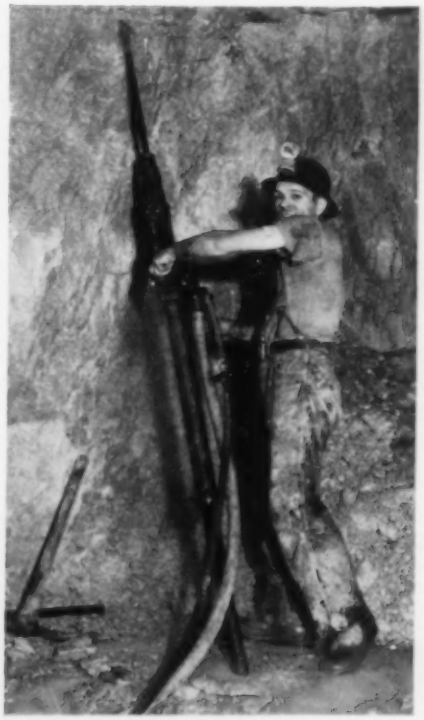
Sunshine has recently started a new development of this rich area by crosscutting north from the 3700-foot level. This crosscut will be in the neighborhood of 500 feet long and will open the Chester vein and fault-fissure zone 1000 feet below sea level, or 600 feet below the lowest present opening on the 3100 level. This will be the deepest mining operation in the Coeur d'Alene district. Sunshine

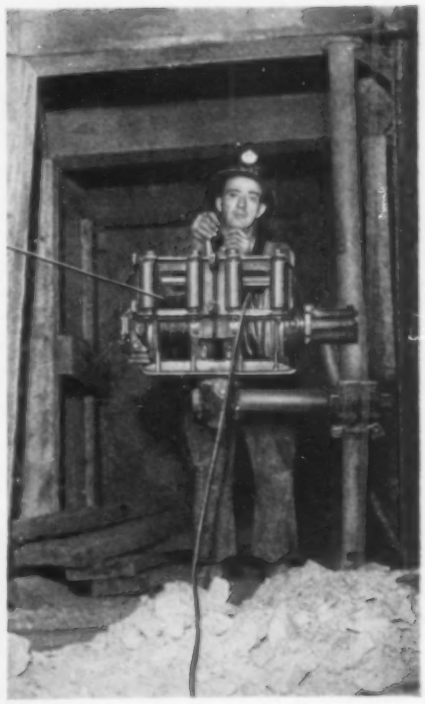
is particularly well equipped for all this new production and exploratory work, having a compressed-air plant with a capacity of approximately 6000 cfm. of free air for the operation of Ingersoll-Rand drilling machines, of which there is a complete line including drifters, stopers, and sinkers. Most of them are idle now for lack of manpower.

Since 1941, Sunshine production figures have not been available because of war censorship; but up to the close of that year the mine has yielded a total of 2,783,776 tons of crude ore from which was recovered 82,949,337 ounces of silver, 27,375,490 pounds of copper, 15,856,053 pounds of lead, and 17,142,691 pounds of antimony. Production from the Chester-vein area for the first six months of 1944 was 56,454 tons (which included 3298 tons from the original Sunshine vein), averaging head assays of 7.56 percent lead and 40.74 ounces of silver per ton. From the concentrated product of this feed, which averaged 227 ounces of silver, 2.3 percent copper, and 52.5 percent lead, the Bunker Hill smelter recovered 2,267,507 ounces of silver, 8,408,077 pounds of lead, and 487,748 pounds of copper. The net smelter returns for this period amounted to $2,082,255.32.

Aside from its mining operations in the Coeur d'Alene district, Sunshine has done many other things in support of the war effort. In 1941 it acted as agent for the Metals Reserve Company in reopening the old Black Bear zinc-lead mining property at Ouray, Colo., and established a manganese-ore purchasing agency at Phillipsburgh, Mont. On its own account, it has developed and placed in production a high-grade manganese-ore deposit on the Olympic peninsula near Port Angeles, Wash.

Further, the Sunshine Company originated and financed the Rare Metals Institute—a research organization—at the California Institute of Technology for the purpose of finding new uses for silver. The institute has made "important progress in the use of silver to produce self-sterilizing plastic surfaces and lacquers," according to the 1942 report of Sunshine's president, R. M. Hardy. "A timely development along this line," he said, "is the method of impregnating bandages and wound dressings with these highly sterile preparations. The American volunteer unit on the Burma Road has reported highly satisfactory results from the use of the carbon silver pellet developed by Rare Metals Institute for sterilizing drinking water." An individual group has recently been formed in Los Angeles to continue this silver research under a license from Sunshine.





Sunshine's first dividend to stockholders amounted to two cents a share and was paid on May 20, 1927, the total for the year being $119,105.76. Six 2-cent dividends were paid in 1928; and from April 20, 1929, the rate varied from two cents up to as high as 50 cents per share. After September 30, 1936, it was increased to 75 cents, and continued at that rate every three months up to and including the December 15 payment in 1937. Since that time dividends have declined to 60, 40, 25, 15, and, finally, to 10 cents a share. The company's leanest year was in 1931, when only one dividend of two cents, amounting to $29,776.44, was declared. The most prosperous year was 1937 when the stockholders received $3 a share, or a total of $4,466,463 in dividends.

During its seventeen years of existence the Sunshine mine has attained a depth of 3700 feet. In that time, although dwindling ore reserves coupled with increased mining costs, state, county, and Federal taxation, government priorities on supplies, and manpower shortage, have forced the company to the lower dividend rate, it has paid its shareholders $23,343,812 up to March 31, 1944. And still underground in the Chester vein area lies what appears to be the biggest and richest ore body so far uncovered in the Coeur d'Alene.

UNDERGROUND SCENES

As in most of our metal mines, use is made of scrapers for transferring and loading broken material. The man at the top is operating a small Ingersoll-Rand double-drum air hoist that hauls a scraper employed for moving waste into a worked-out stope. Sunshine is completely equipped with rock drills of all types, but is right now lacking in manpower to operate all of them. The center view shows a stope-hamer at work. The miners at the left are using two DA-30 drifters, mounted on columns, to advance the heading of a drift on the 2500-foot level. Note the substantial, safe platform on which they are standing.

CAPT. L. F. Small, chief procurement officer of the Navy's Bureau of Ships, and J. K. Salisbury, General Electric Company turbine engineer, (right) are shown examining a scale model of a 3000-hp. continuous-combustion gas turbine built by G.E. for the study of its application to ship propulsion. In a turbine of this type, air is compressed to several atmospheres pressure and then passed into a combustion chamber into which the fuel is injected. The burning of the fuel heats the air, which then produces power in the turbine. About two-thirds of the power is required to drive the compressor and the remainder can be applied to other work. The central, white part of the model represents the air compressor.

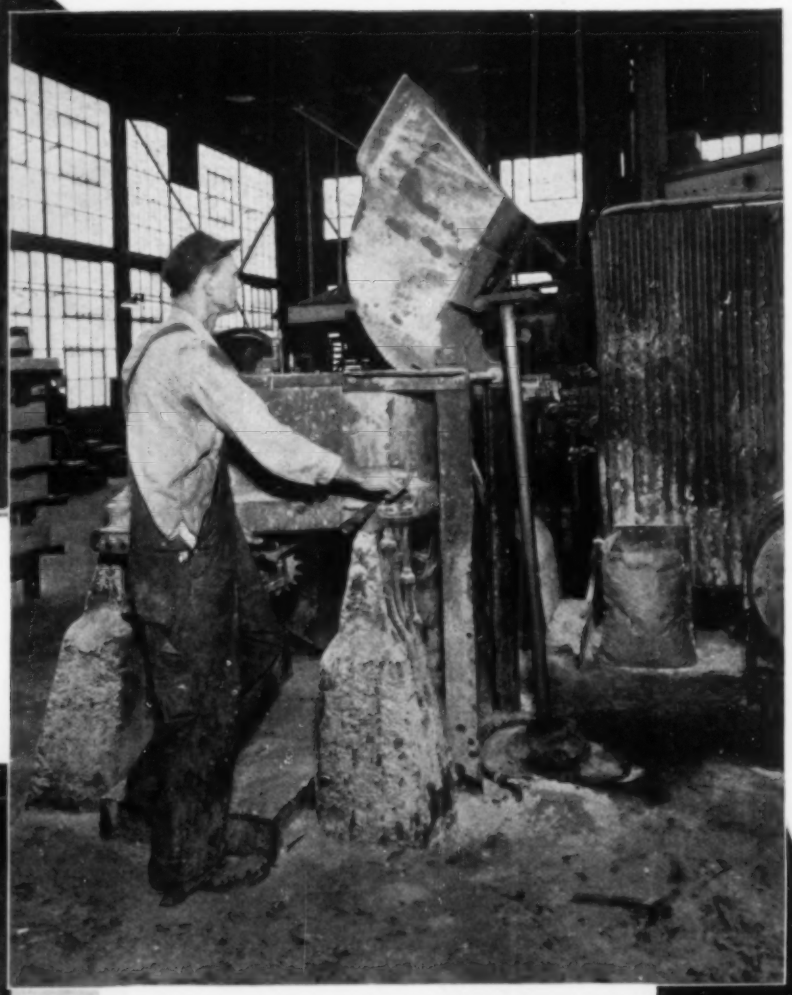
TO FIND out how its products withstand vibration, the Stover Lock Nut & Machinery Corporation of Easton, Pa., uses the test assembly shown at the left. An ordinary air-operated paving breaker, which strikes around 2000 blows a minute, induces vibration. Tests that required several days by older methods are now made in a few minutes.

Compressed Air Institute Photo

LAUNDRIES find that lint and ravelings from the fabrics they handle float in the air and lodge on overhead pipes, underneath machinery, and close to motors where a spark might ignite them. To rid its plant of this accumulation, the Davis Laundry & Cleaning Company of Cleveland "sweeps" once a week with compressed air. During the Sunday shutdown a workman goes through the building, dislodging the fluff and blowing it before him with a blast of air at 75 pounds pressure. The picture at the right shows him attaching a pole to the air hose with clamps to facilitate reaching high points in the room. The same method is used for removing lint from the drying tumblers.

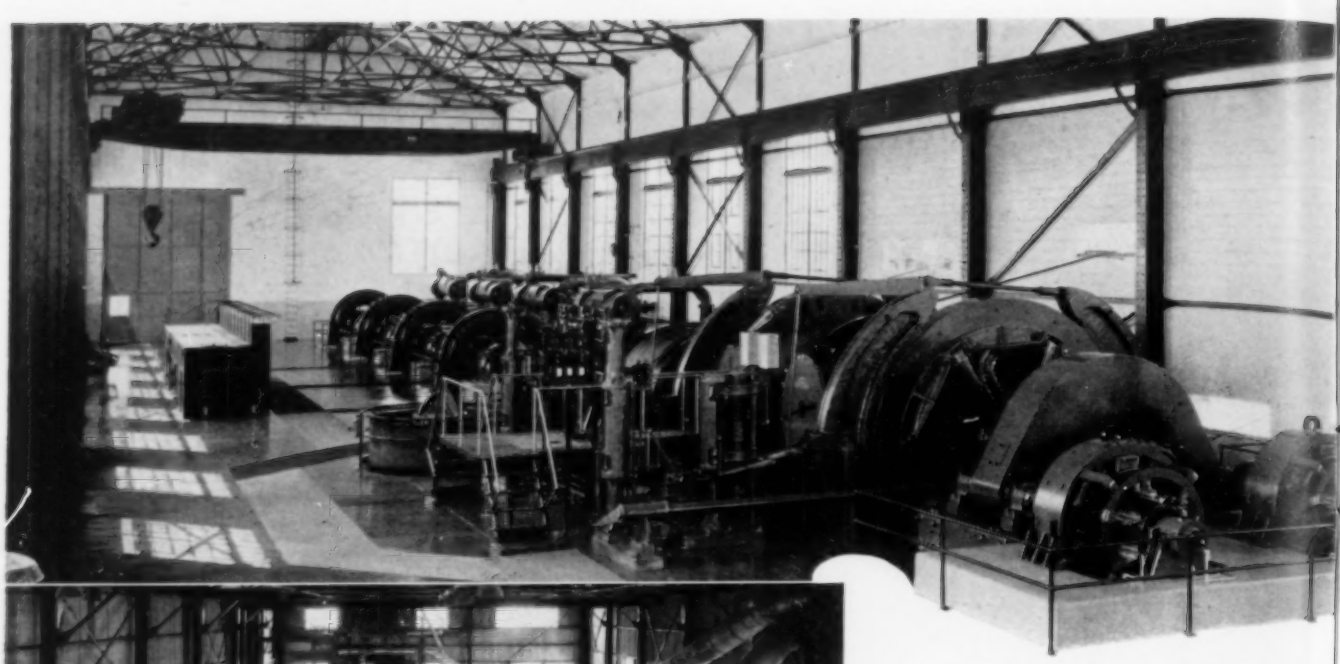
Compressed Air at Work

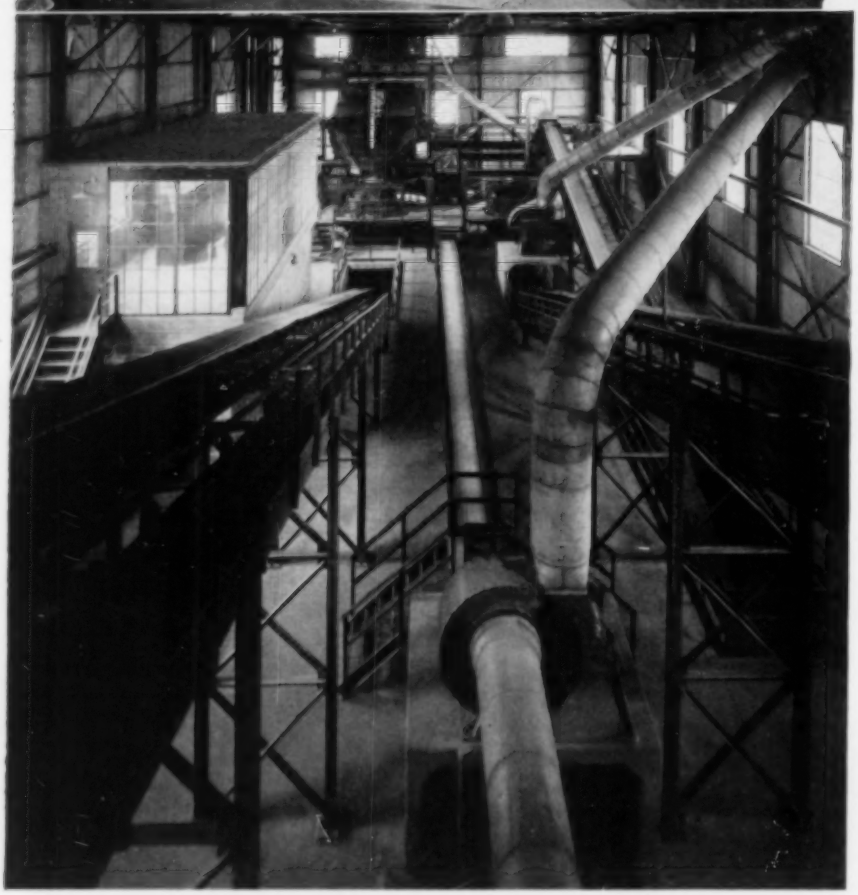
Westinghouse Photo



A COMPRESSED-AIR cylinder beneath the floor level raises and dumps the hopper shown at the left. It is used to place sand in a mixer. Buckets were previously filled with sand, then carried up two steps and emptied into the mixer, which could not be run during the loading operation. Now the worker fills the hopper at floor level while the previous charge is being mixed. The only time lost is when a batch is dumped and a new charge elevated. The hopper is equipped with two rollers that run in channels. The latter have plates on top that stop the upward travel and dump the hopper by means of a hinge attachment, as shown. The air cylinder also is on a hinged mounting that permits the piston to swing toward the mixer during the unloading operation.

WILBORN F. WEGER, a Douglas Aircraft employee, developed the spray-gun attachment pictured at the right for painting small parts. A handful of them is placed in the funnel and the lid closed. The gun is then tilted until the funnel is horizontal and compressed air is admitted, spinning the parts round and round. Next paint is applied with the air and, finally, air alone to dry the parts. Formerly they were spread on a screen, painted on one side, and then turned over to coat the other side. They were dried with air, but many were blown off and others dropped in handling them. The funnel has cut the cost of labor as much as 80 percent.





Old Adirondack Mine Again Producing Iron

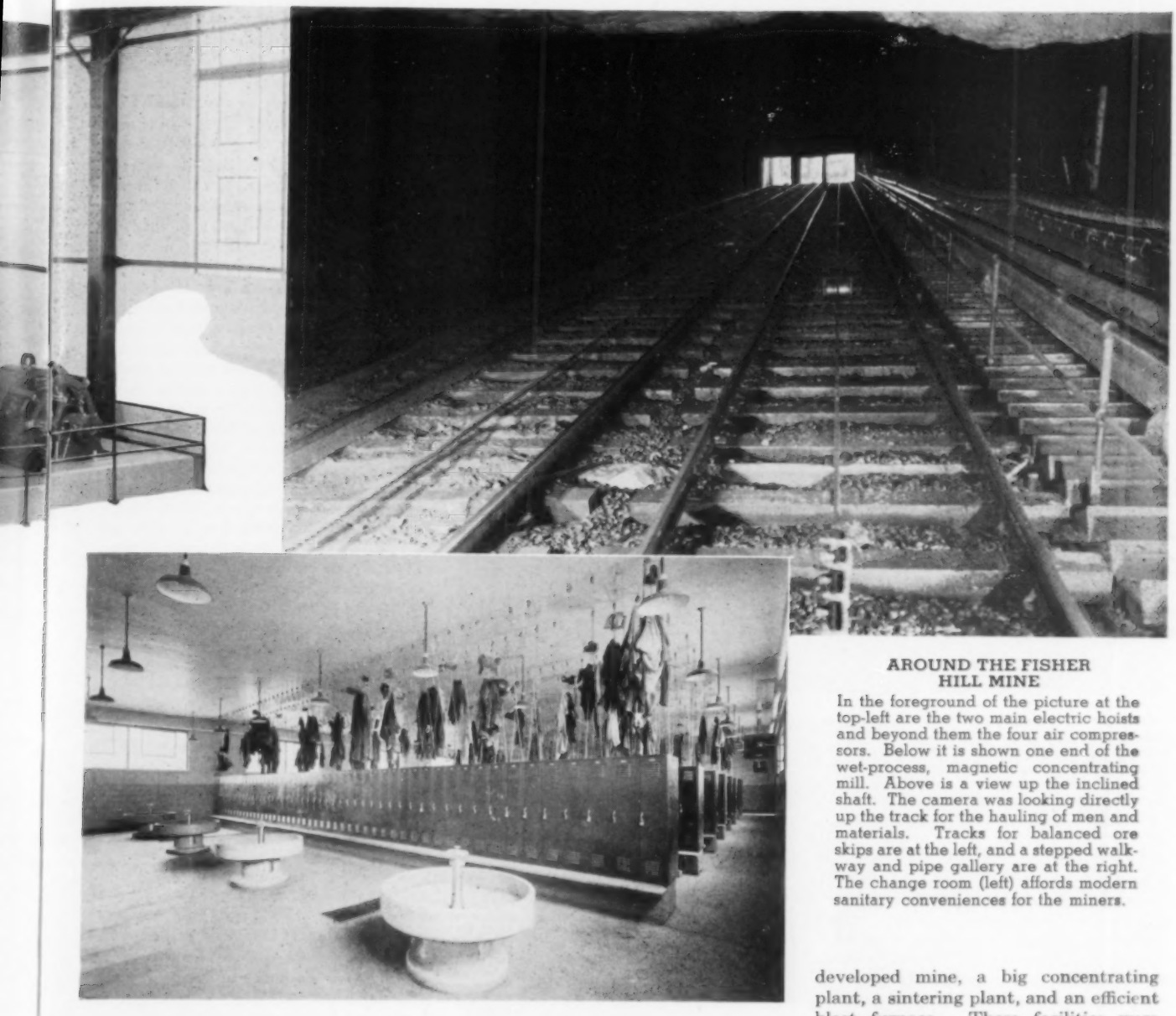
C. H. Vivian

●

NEAR Port Henry, N. Y., the Republic Steel Corporation has recently begun producing magnetite iron ore from its newly developed Fisher Hill Mine, one of a group of old Adirondack properties that it leased from the Witherbee Sherman Corporation in 1938. The new producer is about 2 miles from Mineville, where other mines have been in operation since Republic took them over. Some 80 miles to the north, at Lyon Mountain, the corporation is mining deposits that were developed during the closing years of the last century by the Chateaugay Ore & Iron Company. Republic acquired these properties under a lease agreement in 1939, and recently purchased them outright.

Prior to the opening up of the Lake Superior ores, the Adirondack deposits were among the most important in the country; in fact, two New York counties, Clinton and Essex, accounted for 23 percent of the nation's iron-ore output in 1879. The history of the Port Henry deposits goes back to Revolutionary War times, when they reputedly supplied the ore from which the cannon used at Fort Ticonderoga were made. The first recorded development in the Lyon Mountain area was in 1798 when a man named Platt began operating a Catalan forge on the Saranac River in what is now Plattsburg. For some years those Adirondack properties furnished a large percentage of the ore required by our iron industry, which was then confined almost entirely to the eastern seaboard. Then came the discovery and development of the rich and easily recovered Great Lakes hematites and the birth of the steel industry, which established most of its plants west of the Alleghenies. Before long the New York ores were almost forgotten.

We say "almost," because certain



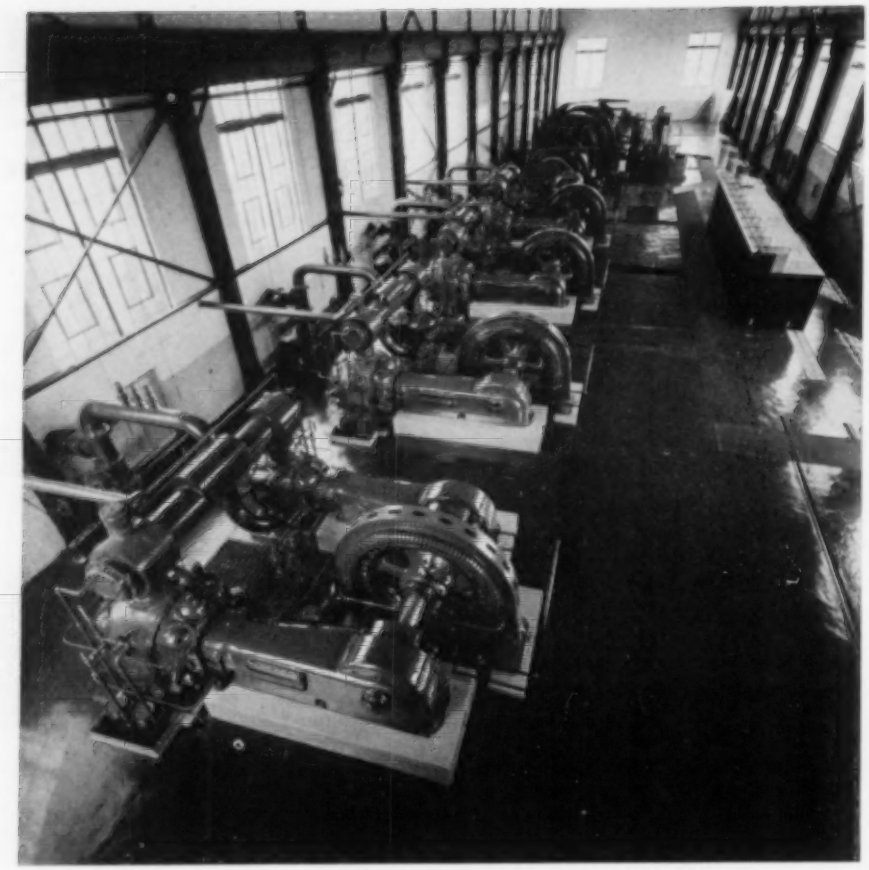
AROUND THE FISHER HILL MINE

In the foreground of the picture at the top-left are the two main electric hoists and beyond them the four air compressors. Below it is shown one end of the wet-process, magnetic concentrating mill. Above is a view up the inclined shaft. The camera was looking directly up the track for the hauling of men and materials. Tracks for balanced ore skips are at the left, and a stepped walkway and pipe gallery are at the right. The change room (left) affords modern sanitary conveniences for the miners.

interests doggedly pursued their mining activities in the face of all obstacles and even achieved a measure of success, which at times reached the proportions of real prosperity. In the Port Henry area those interests were the Witherbees and the Shermans who developed a magnetic separator for concentrating the ores and continually enlarged their holdings and brought additional beds into production, including those that had been owned by the Port Henry Iron Ore Company. When the demand for iron ore mounted during the first World War, there was a boom of considerable proportions in the Port Henry district. With the return of peace it subsided, and the fortunes of Witherbee Sherman & Company declined so much that the concern accepted Republic's offer to lease its properties.

In the more remote Lyon Mountain district, difficulties were even greater than around Port Henry, but the ore was so free from phosphorus that there was a considerable demand for the iron made from it. The Chateaugay Ore & Iron Company, founded by Andrew Williams and Smith M. Weed, persisted in its development, succeeded in getting a railroad into its properties in 1879, set up magnetic separators, and built a blast furnace in 1886 which first supplemented and then supplanted its previously established group of Catalan forges for making bloom iron. In 1903 the Delaware & Hudson Company, operator of the railroad that served the section, took over the Chateaugay interests, and during succeeding years carried out a modernization program which, by 1925, had provided a well-developed mine, a big concentrating plant, a sintering plant, and an efficient blast furnace. These facilities were operated by the company with satisfactory results until they were leased to Republic in the belief that it would be beneficial if the activities were carried on by a steel company having a large and sustained need for iron ore.

The Fisher Hill development was Republic's response to the Government's appeal to increase our iron-ore tonnage to meet wartime requirements. Production from the Lake Superior ranges is limited to the transporting capacity of the ore boats, which are icebound during five or six months of the year, so it was desirable that the deposits opened up should be on or near rail lines to permit shipping the year round. Fisher Hill was satisfactory from this as well as other standpoints. Some mining was done there a long time ago; but the records do not show when. It is known, however, that there has



AIR COMPRESSORS

Another view of the same room that is pictured on a preceding page. Each of the four Ingersoll-Rand compressors delivers 3400 cfm. of air at 100 pounds pressure and is driven by a 700-hp. synchronous motor. The immaculate condition of the room is apparent. The floor has a glossy finish, and visitors are required to stay on the rubber mats.

been no production since 1893, which was a year of great business depression. Soon after the close of World War I, the Witherbee Sherman Corporation and the Port Henry Iron Ore Company financed a diamond-drilling program to determine the extent of the ore body. It was not completed, but was carried far enough to disclose the existence of 40 million tons of milling-grade ore. Dewatering of the mine was started in 1923, but was discontinued. Nothing further was done until the current operations were begun in September, 1941, after plans submitted by Republic had been approved by the Defense Plant Corporation.

The current work has consisted of unwatering the mine; excavating an inclined shaft; constructing a headframe, engine house, shops, change house for miners, crushing plant, concentrating and sintering plants, and railroad facilities; and the purchase and installation of all the equipment required for the operations. These facilities are designed to mine annually 2½ million long tons of crude ore, which will yield a minimum of a million long tons of concentrates and sinter.

The mine was unwatered through an old slope called the Sweeney Pit that reached to a depth of a little more than 1000 feet. The pumps were progressively lowered on a temporary track as the water-level receded. Three main haulage levels were cut at approximately 300-foot intervals along the slope and were extended to the projection of the line of the new slope or shaft that was to be provided. The upper 1000 feet of the latter was then excavated by driving raises from the lowermost of the haulage levels. As the extensions of the haulage levels approached several other small pits that had been sunk from the surface by the early miners, diamond-drill holes were advanced to them for the purpose of draining them. This development scheme made it possible to handle all the water encountered through the Sweeney Pit and by one pumping station.

The new main shaft through which the mine is being operated is one of the largest in the eastern part of the country, being 9 feet 8 inches high by 28 feet 2 inches wide. Except for a stretch near the surface where it cuts through an old pit, it has an inclination of 33°, and diamond-drill holes have determined that it will remain in close proximity to the sloping ore body as it is carried downward even to a distance of 8000 feet. The lower section of the shaft was excavated by sinking, and the work was done under contract by the Stiefel Construction Company of New York City. It is 2000 feet long, and ore is delivered to it by way of five haulage levels with three skip-loading pockets equipped with measuring chutes that hold exactly one skipful of ore. The slope has four compartments: two balanced skipways for handling the ore, another for men and materials, and a concrete stairway and pipeway. The shaft and its hoisting equipment are designed to handle slightly more than 8000 long tons of ore a day.

Because of the difficulty of obtaining new shaft hoists under wartime manufacturing restrictions, two units that had been in service at Republic's Ironton Mine at Ironwood, Mich., were dismantled and shipped to Fisher Hill for reassembly. The hoist for handling men, materials, and supplies is of the single-drum type with 5000 feet of 1⅛-inch wire rope. It is driven by a 500-hp. motor equipped with a hydraulic clutch and runs at a maximum cable speed of 1000 feet per minute. The ore hoist is a double-drum unit with hydraulic clutches on both drums. It is operated by two 1000-hp. motors at a maximum cable speed of 2000 feet per minute. Both hoists are wound with preformed wire rope, as are also the smaller hoists that operate the scraper loaders used in mining. Direct current for the main-hoist motors is supplied by a motor-generator set consisting of a 2200-hp. synchronous motor driving two 750-kw., direct-current generators.

Compressed air for mining and surface operations is furnished by four Ingersoll-Rand Class PRE 2-stage compressors located in the same building that houses the main hoists. Each compressor is driven by a 700-hp. synchronous motor and delivers 3400 cfm. at 100 pounds gauge pressure, or a total for the four units of 13,600 cfm. The air discharged from each machine passes through a horizontal aftercooler for extracting oil and moisture before it goes into the distribution lines.

Detachable Jackbits are used for all drilling work and are reconditioned in a shop near the shaft head that is one of the most modern and complete installations of its kind to be found anywhere. The shop occupies a building with a floor area of 55x69 feet and with windows on three sides and contains sufficient equipment to answer the maximum requirements of the drilling program that has been visualized for the future. The arrangement is such that material passes through the successive stations in orderly sequence, with no back-tracking.

Jackrods are made of hollow steel, being of 1¼-inch round section for

drifter drills and of 1-inch hexagonal section for stopehamers and Jackhamers. New steel from stock is cut into working lengths by an air-operated Size 500 cut-off wheel and then moved to the forging line, which consists of three No. 27-F oil-fired furnaces and two I-R No. 54 sharpeners. One end of a rod is heated and a shank is forged on it; the opposite end is annealed and threaded for the attachment of a bit. The shank end is next ground true to prevent damaging the drill piston that strikes against it, and both ends are heated and tempered in quenching oil. Broken, bent, or worn rods coming from the mine are put through the same process; and when ready for service, all rods are placed in bins in the portal house. To reduce breakage incident to fatigue failure, care is taken to rotate the steel in service.

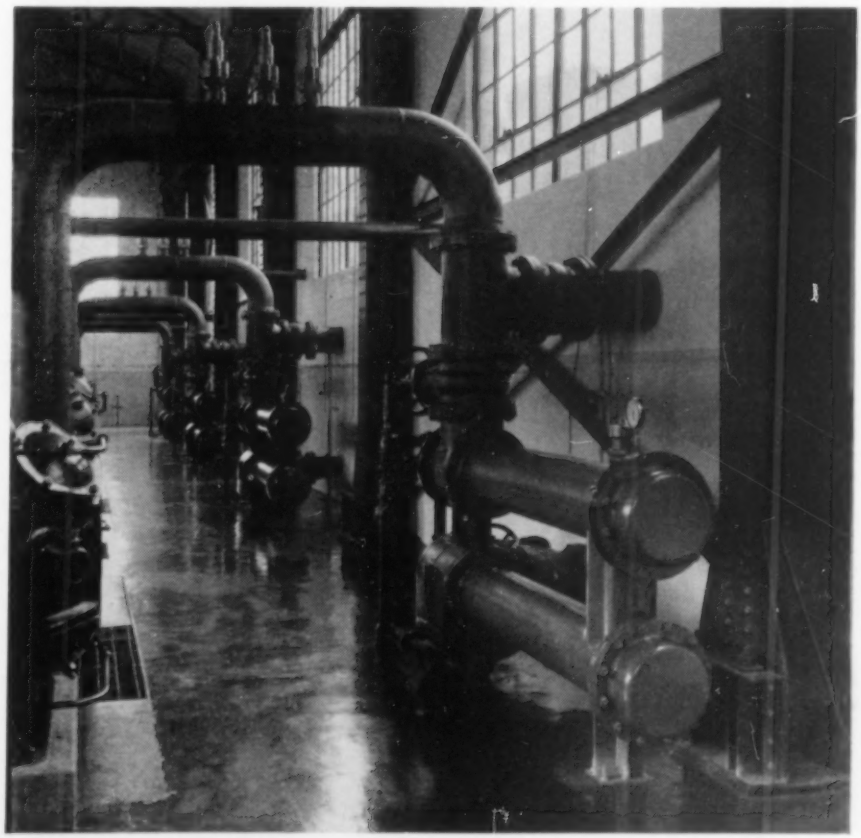
Each miner receives his supply of sharp bits when going on duty. When he comes off shift he puts his dull ones in a small hand truck stationed near the shaft landing. The used bits are hauled into the shop and to a steel sorting table containing bins for each size of bit. Type 1 Jackbits are utilized with Jackhamers and stoping drills and Type 2 with drifters. They are reduced 1/16-inch in gauge at each resharpening. All are reconditioned by hot milling, and there is a sorting table in front of each of the two Ingersoll-Rand JMA Jackmills in service. Separate furnaces are provided for heating the bits for milling and quenching, there being three Jackfurnaces, all pyrometer-controlled.

Following sorting, a batch of bits of the same size is heated to the correct milling temperature and then milled. Two men, an operator and a helper, do the milling. After the cutting faces and gauge have been milled, the bits are placed in steel trays and allowed to cool to atmospheric temperature. They are next hardened by heating them to the prescribed temperature in a Jackfurnace, from which they are removed, one at a time, with a long-handled tool and put on an automatic quenching fixture. The latter has some unusual features and is an adaptation of a similar unit that was developed at Republic's Mineville properties. It is of the rotary type and has eighteen stations. When a bit is placed on one of them, water rising around the wings and through the center hole hardens it to the exact height desired. The speed is controlled so that the proper chilling effect is obtained in one revolution. After a bit has completed its travel, it is picked off its station by an electromagnet, then dropped on a slide from which it falls into a hot-water bath below the floor level. The effect of the hot water is to normalize the steel. The intensity of the magnet is sufficient to cause the bit to hit it with considerable impact. This jolt and further jarring of the bit when it falls on the slide remove any scale that may be adhering to it.

The entire hardening operation is automatically controlled and, consequently, no errors in human judgment can be made. The Jackfurnace is equipped with a pyrometer to insure correct preheating. The rotation of the quenching fixture is accurately timed, and the action of the magnet is made automatic by a control mechanism. As a result of this precise heat treatment, the drilling footage per bit is substantially greater than it was when the "human-element" method was practiced. In addition, the automatic-control system has eliminated one shop man and has increased the capacity rate of hardening bits from 100 to 1000 per hour.

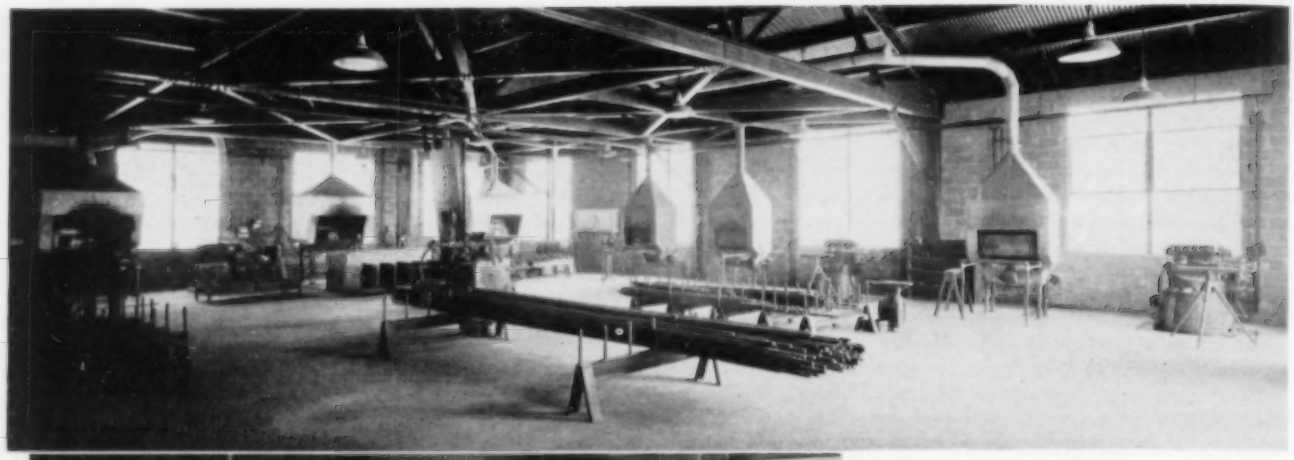
A wire basket in the hot-water bath receives the bits as they drop from the quenching fixture. After they have remained in the water the proper length of time the basket is removed by means of a chain hoist and the bits are dumped on a sorting table. The different sizes are distributed to individual bins, and from these the supply for the miners is made up. The bits are strung on wires, each machine man receiving three new ones for starters and three reconditioned bits of each of four sizes—a total of fifteen. The strings of bits are moved by hand truck to a point near the shaft landing to be picked up by the drillers. Dull bits are returned at the end of the shift on the same wires, which are thus used over and over.

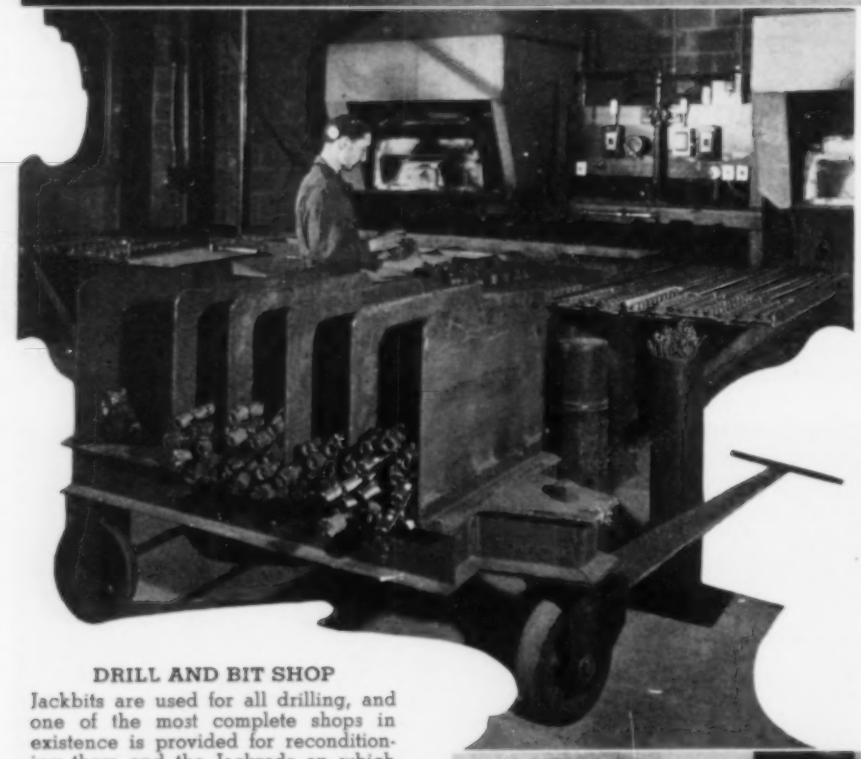
A section of the drill shop is equipped for repairing and reconditioning the various types of rock drills in service and is located so that the work done there does not interfere with other shop operations. All drills in need of repair are brought to this surface shop, which is near the stock of spare parts for convenience. Closer supervision is possible there than underground, and this results in better work with less lost motion. The possibility of losing parts is also eliminated. An overhead boom with an air hoist enables the drill doctor to handle the machines easily. A booth is provided where each drill is thoroughly cleaned with compressed air and cleaning fluid when it comes in for repair. Before it goes back underground, it is given a fresh coat of paint. It has been found that there is a psychological advantage in this, as miners are inclined to handle a drill more carefully if it has the appearance of being new. All drill-shop furnaces have full metal hoods connected to an exhaust pipe system. Suction is provided by a blower and removes all fumes and gases from the room. This feature, together with numerous safety devices, insures the shop crew a clean,



AFTERCOOLERS

Air discharged from each compressor passes through a horizontal aftercooler that extracts excess moisture. It is then piped through the wall to outdoor receivers, from which it enters the delivery lines.





DRILL AND BIT SHOP

Jackbits are used for all drilling, and one of the most complete shops in existence is provided for reconditioning them and the Jackrods on which they are used. At the top is a general view of the shop, with sharpeners and furnaces arranged along the right-hand wall and Jackfurnaces and Jackmills along the left-hand wall. The center picture shows the table where sharp bits are strung on wires and placed on the truck in the foreground to be wheeled to the shaft landing, where the miners obtain t em as they go on shift. The man at the bottom is sorting bits and putti g them into bins according to size.

healthful place in which to work and promotes efficiency that more than repays the company for the outlays.

The Fisher Hill magnetite is classified as a Bessemer-grade ore and contains from 25 to 30 percent iron, as mined. This is increased to 68-69 percent by magnetic concentration. The new mill for this purpose consists of three independent units and has a capacity of 300 tons of concentrate per hour. Because it is a wet mill, it had to be situated where the most dependable supply of water was available. Also, because the highly abrasive crushed ore is very wearing on pumps, a site was selected that was favorable to gravity flow. The mill is on the railroad line between Mineville and Port Henry at a point where water is obtainable from a brook. To provide an auxiliary supply, a 16-inch steel line was laid to the mill from a pumping station on the shore of Lake Champlain.

The design of the mill follows, in general, that of similar ones in the district but embodies improvements that were developed in those plants. The magnetic separators, which are patterned after units that were tested for two years in the Port Henry mill, have a greater capacity than those heretofore used and make a cleaner product, especially as to the percentage of phosphorus, which is reduced. In addition to the separators, the mill equipment consists principally of grinding mills, vibrating screens, and filters.

The concentrate is sintered in a new plant adjoining the mill. The operation is continuous, there being two machines with individual capacities of 1500 long tons a day. Fine anthracite culm is mixed with the concentrate and ignited on top as it begins its travel on a 72-inch-wide conveyor. Air is drawn down through the mixture, the necessary suction for each unit being induced by a 100,000-cfm. fan and applied through fourteen wind boxes. The mass is thus fused and converted into a product which, when cooled and broken into lumps, is suitable for charging into blast furnaces.

As a part of its development program in the area, Republic has improved the railroad system between Port Henry and the various mines. This line, the Lake Champlain & Moriah Railroad, was originally built in 1868-69 and rises 1300 feet to Mineville, with grades ranging up to 4.2 percent. From Mineville it extends to Fisher Hill. The first locomotives used each weighed 35 tons and hauled 4-wheeled cars that held 5 tons each. Later on, heavier rails were laid and larger equipment was put in service, and in 1938 the rolling stock numbered two 65-ton steam switching locomotives, two 85-ton main-line steam locomotives, and about 100 two-hopper dump cars with a capacity of 50 tons each. A new 1000-hp., 125-ton diesel-electric locomotive and 50 cars of 60 tons capacity were purchased in 1940, when the steam equipment was retired. The diesel has modern braking devices, and the cars are equipped with an automatic and a Westinghouse straight air-braking system, These auxiliaries make it possible to hold loaded trains on the steep descent and eliminate the former dangerous practice of brakemen riding the cars. A duplicate diesel locomotive was added after the first one had hauled 1¼ million long tons of ore to Port Henry in one year and done all the switching work besides. The tonnage carried per train by the steam equipment has been almost doubled, and transportation costs have been materially reduced.

The operations of the Republic Steel Corporation in the Adirondack District are under the management of J. R. Linney. His two sons, Robert J. and William J., are superintendents of the Port Henry and Chateaugay divisions, respectively.

OTHER SHOP VIEWS

The man below is sharpening a Jackbit in a JMA Jackmill. The quenching apparatus where sharpened and heated bits are hardened is shown at the top. The bits are hardened by rising water in one revolution of the 18-position turntable. An electromagnet picks each bit off as it completes its trip and drops it on the slide in the foreground, which directs it into a hot-water bath beneath the floor level. Rock drills are cleaned and repaired in one section of the shop. A booth, served by an exhaust fan, is provided where each machine is gone over thoroughly with compressed air and cleaning fluid. bottom-right.

Tunneling at Gibraltar

Canadian Army Photos

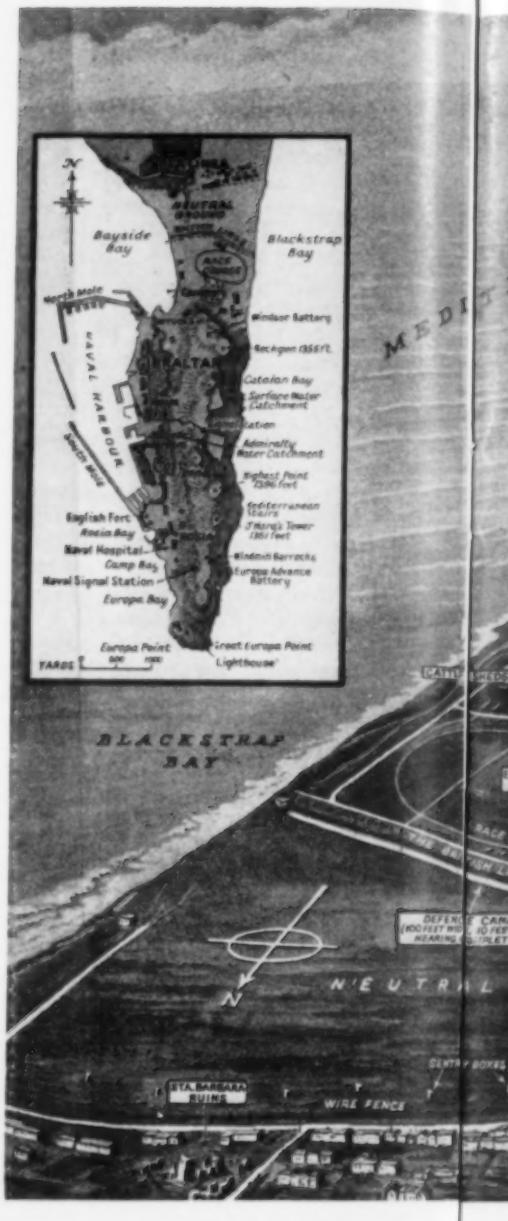
DURING the past several years there have been occasional meager reports of extensive construction work at Gibraltar, including tunneling of the "Rock" itself, but details have been withheld in the interest of military security. Now that the operations have long since been completed and there is only a remote probability that the British bastion will be attacked, it is possible to give a partial account of what was done there. Engineering troops of both the British and Canadian armies were engaged in the effort, and what we are now able to print concerns principally the part played by the Canadians.

Because of the importance of mining in the economic life of the Dominion, it is only natural that its technical knowledge and skilled personnel should be drawn upon for specialized warfare operations. Canadian mining men assisted in similar activities in World War I, and the industry knew even before hostilities began in 1939 that its resources would very likely be called upon again in this war. Months before Hitler's legions began to march, the industry proposed to the British and Dominion governments that Canadian mining engineers be sent to Europe to study the possibility of attacking the German Siegfried Line by drilling long horizontal diamond-drill holes that could be loaded with explosives. This was the beginning of a movement that subsequently resulted in Canadian engineering troops spending some two years at Gibraltar.

On September 16, 1939, J. Y. Murdock, president of Noranda Mines, Ltd., acting for the Mining Fraternity of northwestern Quebec and northern Ontario, outlined a concrete plan for diamond-drilling the Siegfried Line and offered to do anything he could to further its execution. At the same time, he urged that a military unit composed of men experienced in handling diamond drills be formed and sent abroad to conduct experiments under the direction of military engineers who had been on the Western Front in France during the previous war. In the following month, Robert A. Bryce, president of the Ontario Mining Association, informed the authorities that the Canadian mining industry was ready to finance the sending of two or three engineers abroad to study the situation in company with an experienced British military adviser. The British War Office expressed interest and promised that the proposals would receive attention.

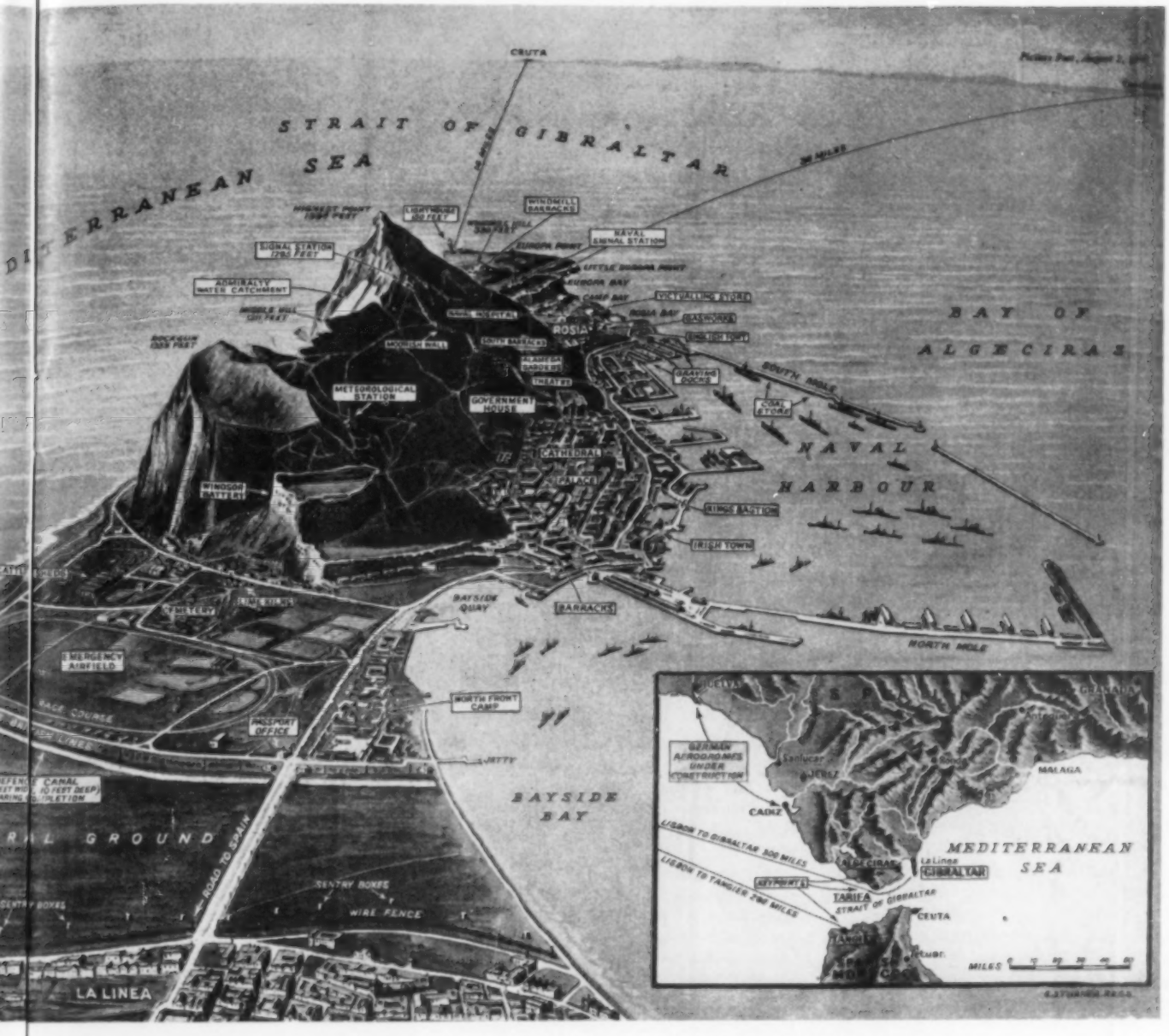
Upon being made inspector general of the 1st Canadian Division on October 5, 1939, Gen. A. G L. McNaughton confered with proponents of the diamond-drilling scheme, and soon afterward requested the Hon. C. A. Campbell, minister of public works in the provincial government of Ontario, to recruit a special section of hard-rock miners for carrying on experimental work. Mr. Campbell, who was also a lieutenant in the Royal Canadian Engineers, proceeded to do this; but as government funds were not available for that purpose, the money for outfitting the unit was contributed by various mining companies, who were solicited through an organization known as the War Time Mining Association. In January, 1940, Lieutenant Campbell and his soldier-miners embarked for England with 25 tons of diamond-drilling paraphernalia.

Experiments were conducted for several months, and in April a demonstration was given before various British and Canadian military authorities. They were so impressed that the work was ordered continued, and it was also decided to recruit additional men to permit forming No. 1 Canadian Tunneling Company. The Dominion Government agreed to provide the necessary funds, and arrangements were made with Canadian manufacturers of mining and drilling equipment to supply the company's needs. Meanwhile, the group in



SOME OF THE SOLDIER-MINERS

Maj. J. G. Tatham of Larder Lake, Ont., center, and some of the other northern Ontario hard-rock miners who served with one of the tunneling companies.



GIBRALTAR AND VICINITY

An artist's drawing of the famous promontory as it appeared before the war began. This illustration was published in the London "Picture Post" on August 2, 1941. The inhabited area is about 3 miles long. Civilian residents were evacuated in September, 1940, more than 12,000 of them having been housed in London. The first contingent of 1400 returned last April, and most of the others have gone back in recent weeks. Modern tunneling of the Rock began in 1900, when a reservoir for supplying water to the base was provided underground. Contrary to general opinion, little additional subterranean work was done until the present war broke out.

England was asked to go to France to drill signal-cable holes that would be invisible from the air for the British Expeditionary force, but the unexpected speed with which the Germans overran France canceled those plans. The unit then applied itself to the construction of a hydroelectric project in Scotland, to the reopening of old Cornish tin mines, and to some other special tasks that are still military secrets.

In October, 1940, the British Government urgently requested that Canada provide some experienced mining men to assist in building defensive works of considerable magnitude at Gibraltar and to train British tunnelers in the use of diamond drills. Responding to this appeal, approximately 100 men from No. 1 Tunneling Company, headed by Mr. Campbell with the rank of major, sailed on November 15 and reached Gibraltar eleven days later. They were the first Canadian troops ever to be stationed on the Rock, although Great Britain has controlled it for two and one-half centuries.

The word Gibraltar is a corruption of Jebel Tariq (Mount Tariq). Tariq ben Said, Moorish military leader, was the first to fortify the Rock, having erected there, in 742 A.D., a formidable castle of which parts still remain. Gibraltar was taken by Spain in 1309, retaken by the Moors in 1333, and became Spanish again in 1462. Spain attempted to make it impregnable with fortifications designed by the engineer Daniel Speckle, but during the War of the Spanish Succession, British and Dutch troops routed the defenders. Acting on his own responsibility, the British admiral Sir George Rooke caused the British flag to be raised there and took possession of the eminence in the name of Queen Anne, whose government ratified the occupation.

Spain besieged the garrison in a memorable campaign from 1779 to 1783, but was unsuccessful in starving it out. Since then there has been little fighting at Gibraltar. During World War I its chief importance was as a coaling station for Allied naval vessels. The under-

TROPHY GIVEN EACH MAN

In recognition of the services performed, each man was presented with a silver watch fob consisting of a medal superimposed upon a Gibraltar Key. The two sides of one of the medals are shown here.

ground fortifications were begun during the Spanish siege, and additional work has been done from time to time. In this war, Gibraltar has been all-important in keeping open the entrance to the Mediterranean, an important link in the short route to the Orient, and it is easy to understand why Great Britain expected it to be attacked and hastened to strengthen its defenses.

Little tunneling work of military significance had been done since the last war, and a program of considerable magnitude was laid out in 1940. Civilians were evacuated, the race track was converted into an airdrome, pill boxes and concrete forts were erected, and the work of hollowing out underground caverns in the Rock was started. British tunnelers were the first on the job and worked with the Canadians, who got down to serious operations in March, 1941. Meanwhile, to meet the demand for more men, No. 2 Tunneling Company was being organized in Canada and was dispatched to Gibraltar in March under the command of Maj. C.B. North.

The principal job delegated to the Canadians was the excavation of a great hospital within the Rock where it would be safe from attack. This is called Gort Hospital, after the then British governor of Gibraltar who was commander-in-chief of the British Expeditionary Force in 1939-40. Huge rooms were carved out of the limestone promontory, the largest being the wards which measure approximately 200x35 feet and are 12 feet high. The tunnelers entered by way of the east face, using equipment and methods that had proved effective in the metal mines of the Dominion. Floors were finished and leveled with concrete, walls and partitions sheathed with wallboard, and ceilings faced with corrugated iron. Because the rock stands firm, little timbering was needed.

In addition to the hospital, a main tunnel was driven and christened Harley Street, after a London thoroughfare where many doctors have their offices. It is 1200 feet long, 12 feet wide, and 12 feet high; and numerous rooms open from it. Near its inner end the bore was chambered to provide space for a laundry. This was the largest single opening made by the Canadians, requiring the removal of about 11,000 tons of rock. Aside from these major activities, they excavated rooms to serve as ammunition dumps and for the storage of oil tanks. On the outside, they helped build pill boxes and forts. Considerable time was spent in instructing British engineers how to use the conventional mounted wet-type rock drill. They had been working with the hand-held dry type which is not well adapted for heavy tunneling work.

During their two years at Gibraltar, the Canadians excavated approximately 140,000 tons of rock underground. From May to December, 1942, a period of eight months, 72,000 tons was removed. The best week's performance was 4,832 tons, an average of 800 tons a day, or 4 tons per man-shift. The last shift was finished on December 5, and on the fourteenth the tunnelers embarked for England, where they were assigned to other work. As this is being written, for all we know to the contrary, some of them may be testing the effectiveness of the plan to diamond drill the fortifications of Germany's vaunted West Wall.

Before the Canadians left Gibraltar, other of their countrymen arrived there on a special assignment. Under command of Capt. H. W. DeMorest, in private life the proprietor of one of Canada's largest diamond-drilling companies, they came in response to a request for a contingent to assist in a project that involved "a large amount of quarrying." This turned out to be the lengthening of airfield runways so that they would be adequate for the largest aircraft in service. It was necessary to extend one of them out into the sea, using material taken from the base of the Rock. Because the blocks of stone were too large to be handled by the available power shovels, the familiar placer-mining method of hydraulicking was resorted to, and it worked out well. In this manner large boulders were brought down from the base of the cliff and were then broken up by drilling and blasting. It was from these runways that American and British planes took off in support of the invasion of North Africa in November, 1942.

Each of the Canadian tunnelers who served at Gibraltar was awarded a silver watch fob designed by Sapper R. J. Cunningham, one of their number. As shown in an accompanying illustration, it is in the form of a medal superimposed upon a Gibraltar Key. The latter has great significance in Gibraltar military circles, and the ceremony of handing over the keys has been a part of the routine of changing the guard at the garrison ever since the Spanish siege 161 years ago. The medals were minted in Canada and were paid for by Mr. Murdock, one of the first members of the Canadian mining industry to suggest that men from the Dominion's mines might render valuable war service if given the opportunity.

IN COMMAND

Brigadier Colin A. Campbell, who organized the first unit of tunnelers and commanded the forces that spent nearly two years at Gibraltar.

From Smoke Signals to Morse Code

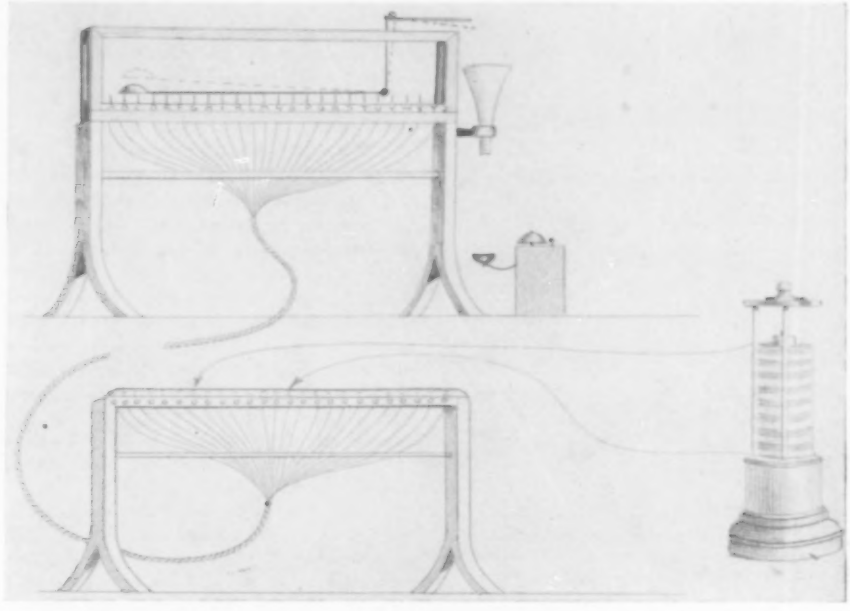
Vincent Colby

Drawings by the Author

EVER since the human race has used the spoken word, some form of telegraphy has been used for communicating between distant points. We all know of the smoke and fire signals of primitive tribes and of the eerie sound of distant drums in the jungles. Refinements in methods were gradually evolved until, during the Napoleonic Wars, a system of semaphore signaling was introduced that was astounding for that time. Weather permitting, messages could be transmitted in a matter of hours which otherwise would have taken many days to deliver. This was the Chappe system, and consisted of appropriately placed towers provided with moving arms and wire contraptions.

Napoleon and his armies thus gained an advantage over their opponents, as is proved by at least one historical event. This was in April 1809 when the Austrians, then enemies of France, decided to have a little Blitz of their own. They occupied the city of Munich, a name now so familiar to all of us, and chased the ruler, Grand Duke Max Joseph, out of his domain. However, the Austrians had not reckoned with the efficient Chappe telegraph. Messages of the happenings, wigwagged to Napoleon in Paris, brought him speedily to the rescue of the Bavarians. Within fourteen days the Austrians were back in their own country.

There was a victory celebration and dinner in Munich, an assembly of dignitaries and generals. Among those present were the Bavarian Minister Count Monteglas and a Dr. Thomas von Sommerling of the Bavarian Academy. The latter had been doing much experimenting with a new-fangled scientific force called electricity, and was explaining how speedily an impulse of that kind transmits itself over a wire of a certain length. Monteglas, who had been talking about and praising the unheard of efficiency of the Chappe system of communication, was immediately interested. "Well Doctor," he asked, "How about applying your electricity to the transmission of messages?" Sommerling accepted the challenge at once.



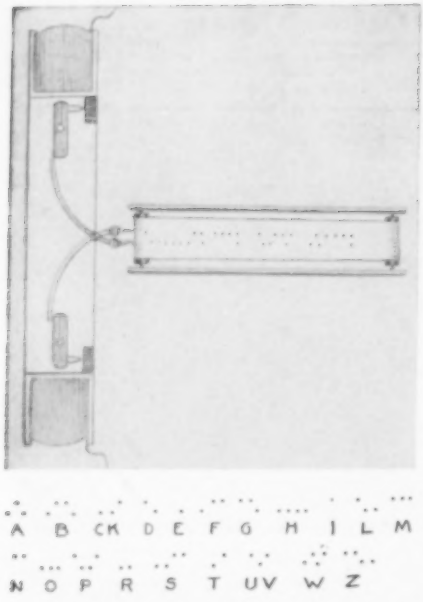
FIRST ELECTRIC TRANSMITTER OF LETTERS, 1809

1837 INSTRUMENT
Developed in England by W. F. Cooke, with the aid of Wheatstone.

Eight weeks later, Sommerling came out with a contraption which, while unique even if impractical, can be called the first transmitter of messages by means of electricity and wires. I say wires, not just a wire, because there was a separate wire for all but one letter of the alphabet. The receiver consisted of a bowl partly filled with water that was slightly acid. Within the bowl, a little underneath the surface of the water, there were 25 metal points—gold points, in fact, each of which was connected with a separate wire insulated with varnish. Upon contact from the other end, a gas bubble (hydrogen) would be liberated from the particular point representing a given letter. This, without going into technical details, was the principle of operation. However, the method of calling the party at the far end was unique.

As can be seen from an accompanying illustration, a spoon was placed over two of these points so that, upon contact, its bowl would be lifted somewhat by the hydrogen bubbles. This caused a little metal ball, resting in a grooved bar mounted above the spoon and connected to its handle, to roll down the groove and to drop through a funnel into a small shell with sufficient force to depress a spring. The latter, in turn, actuated a bell, and "bing" the call was made. Even Rube Goldberg could not have improved upon that one. Of course, the contrivance was merely a novelty, and there is no record that it was ever put to actual use, for it was far too expensive. The Chappe telegraph was still serving two decades later. During this period, a Doctor Schweiger of Heidelberg tried to improve on the Sommerling device by signaling by means of the same gas bubbles but utilizing only two wires. However, his efforts, too, turned out to be impracticable.

One of Professor Sommerling's friends was the Russian Baron von Canstadt, who became so interested in the Sommerling apparatus that he took it to Russia and showed it to the Czar. And so the germ of the idea of using electricity for the transmission of messages was born. In the meantime, Ampere had discovered the phenomenon of electrodynamic action, Oested the action on the magnetic needle, and Schweiger the coil. These discoveries gave von Canstadt an altogether new idea. He made an instrument by hanging a magnetic needle inside of a coil of wire by a fine silken string. Ultimately, there were five needles, and to each was attached a square bit of paper which, under the current impulse, would turn and present to the onlooker either the edge or the upper or underside. In this manner he transmitted symbols. The arrangement



STEINHEIL TELEGRAPH

Magnets and coils actuated two needles which left dots on a paper strip that moved like an endless belt.

likewise was impractical but it was a tremendous incentive towards further development of the telegraph. This came about as follows.

It happened that a Professor Munkel of Heidelberg University used a model of von Canstadt's apparatus in lecturing to a group of nature scientists. Among them was a young Englishman, who subsequently mentioned this particular discourse to a countryman of his, a young man named William Fotherill Cooke. The latter was also studying at Heidelberg, but principally anatomy and the making of anatomic wax specimens. Cooke obtained a model, took it to England, and then gave himself entirely to the problem of developing a practical method of communication.

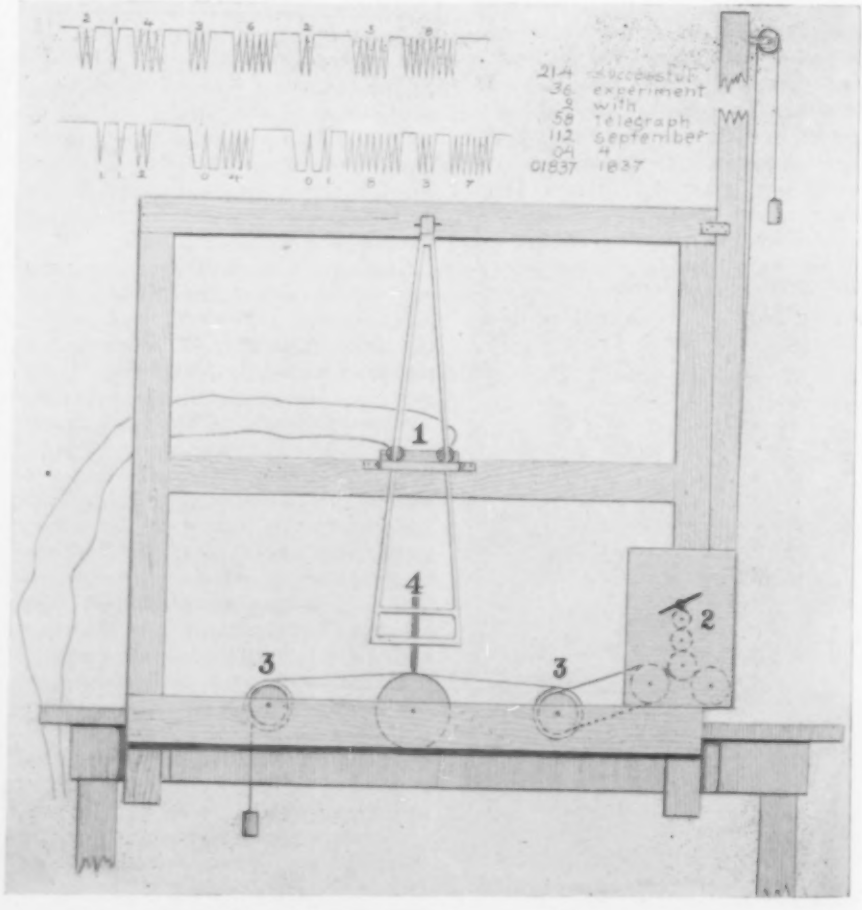
Since Cooke was not a physicist, he made a connection first with Faraday and later with Wheatstone, who agreed to collaborate with him. The most difficult period of every invention is the one spent in making it commercially practicable, and this young Englishman must be numbered among those who, in great measure, did that for telegraphy. A 5-needle instrument was finally built and a patent applied for and obtained in England in 1837. It was first used on the Birmingham Railroad on July 25, 1837. As one of the drawings shows, a pointer swung to right and left, and this, together with the manner of its movement, indicated a letter.

The efforts of Cooke and Wheatstone constituted merely the English branch of the endeavor; and, after all, a pointer telegraph could make no lasting record. Others, even before Cooke, had worked on a system which would leave a written message and had in a manner succeeded, but their machines were still only experiments. There was Steinheil, for example, who was the first, according to the Germans, to make this possible by using the ground as a conductor. A part of his apparatus is illustrated and is virtually self-explanatory. It is claimed that he was able to transmit six words per minute.

The American phase of this work came with Morse who, after all, not only produced a practical telegraph but invented a practical code which, with improvements, is in use today. It is interesting to observe how this came about, and to consider the endless labor and effort Morse must have expended before he attained success. As one of our great engineers and inventors once aptly remarked, "The period beginning with the conception of a useful idea and ending with its ultimate practical use is the lose-your-shirt period," and Morse did not have an easy time of it.

In the year 1835, while returning from Europe on the packet *Sully*, Samuel Morse became acquainted with another passenger, a Doctor Jackson, who had entertained the ship's company with a description of electromagnetism and its use in the transmission of symbols. Even at that time the achievements of Sommerling, Gaus, Weber, and others were known to physicists; and Morse, although an artist, had that "something" for which artists are generally known, imagination and perception. With his knowledge of the graphic arts, Morse at once realized that a telegraph instrument, to be practical, would have to leave a written message. He now worked on this idea continually, and after two years had produced a model that was really promising. He employed a sort of zigzag script for symbols which required a key to decipher them.

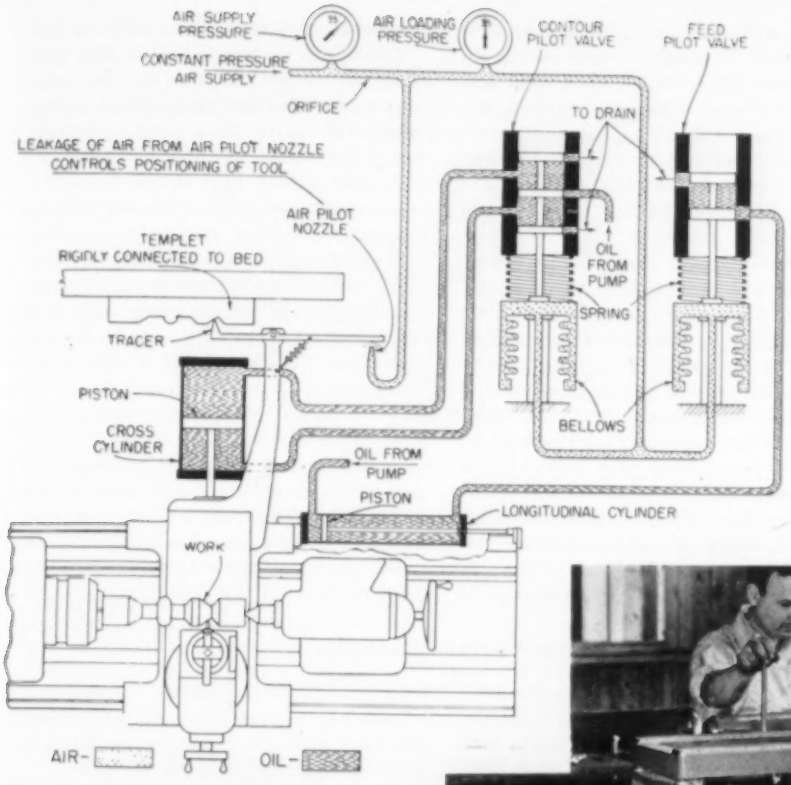
By 1840, Morse had invented a code and also an instrument which, in principle, has been used ever since. The receiving apparatus was provided with a clockwork that moved a paper strip from a spool; and the magnets with their levers and inking arrangements remained unchanged for years. His transmitter, too, was practically the same as that on which many a young man later learned to send wires. The first American telegraph line was erected between Washington and Baltimore a century ago, but it was not until 1848 that the Morse Code and method were generally adopted in Europe.



MORSE'S FIRST WRITER TELEGRAPH

1- Magnets; 2- clockwork and governor; 3- paper spools; 4- stylus. A sample of the zigzag script that served as a code appears at the top.

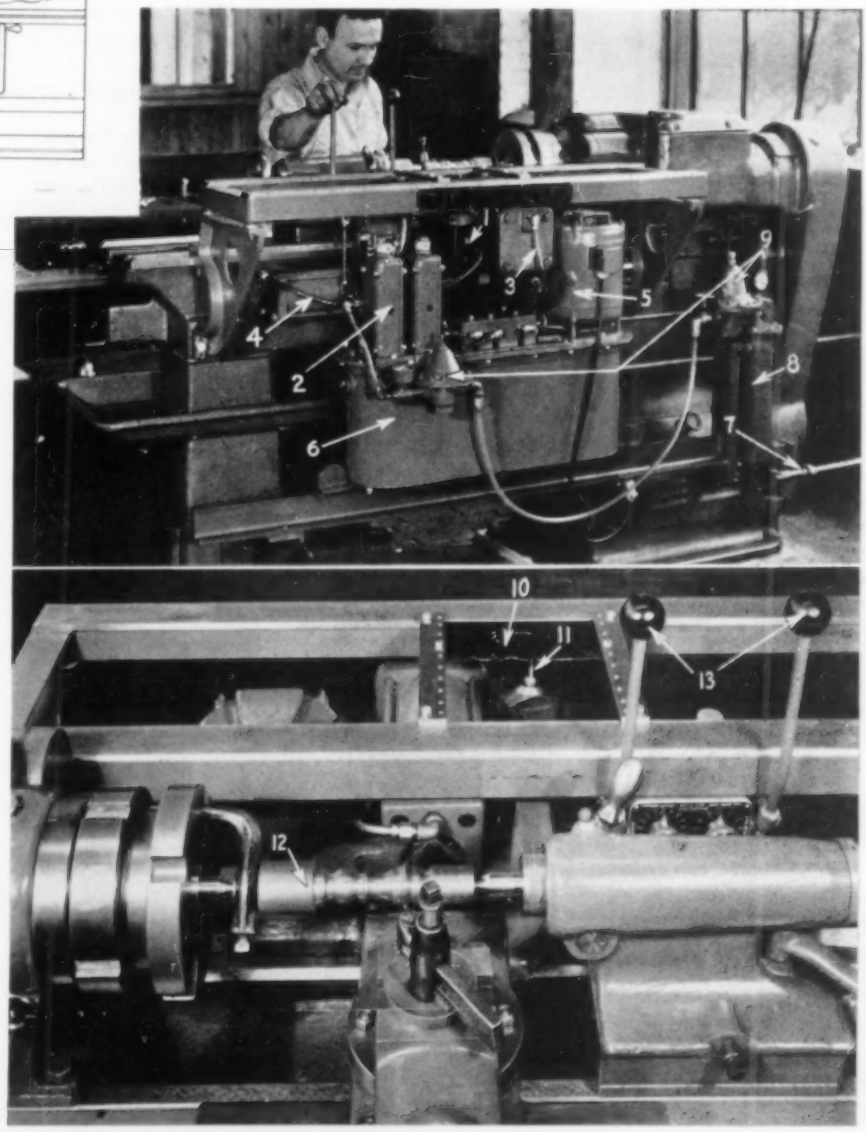
Automatic Contour Control for Machine Tools



CYCLE OF OPERATIONS

At the start, when the cutting tool is not in contact with the work, the flow from the air pilot nozzle is decreased by the tracer and the air loading pressure increased above the neutral value of 35 pounds per square inch. This causes the contour pilot valve of the hydraulic system to move upward and to open the rear chamber of the cross power cylinder, draining it. Hydraulic pressure in the front chamber of the cylinder then forces the piston back, thus moving the cross slide of the lathe, the tool, and the tracer inward. This brings the stylus in contact with the template and the cutting tool with the work, increasing the flow of compressed air from the pilot nozzle. When the air loading pressure again reaches "neutral," the cross slide stops. At this pressure the contour pilot valve returns to its neutral position, as shown, locking the cross slide by applying hydraulic pressure equally to both sides of the cross cylinder. Longitudinal feed is controlled by the feed pilot valve which, in effect, throttles the oil drain from the longitudinal power cylinder in accordance with variations in air loading pressure. Maximum drainage from this cylinder and, consequently, maximum longitudinal feed, occurs when the air loading pressure is at the neutral point—35 pounds. Either an increase or a decrease in this pressure decreases longitudinal motion, and if the deviation is great enough, the carriage stops and only the cross slide is in action.

THROUGH a combination of pneumatic and hydraulic systems, the new Bailey Meter Company Contour Control for machine tools does automatically what is normally done painstakenly by skilled mechanics with the aid of micrometers or forming tools and



CONTOUR CONTROL IN SERVICE

At the top is a back view of a 12-inch Hendey lathe showing compactness of the pneumatic-hydraulic system. The essential features are: 1, air pilot nozzle; 2, hydraulic pilot valves; 3, cross cylinder; 4, longitudinal cylinder; 5, motor-driven oil pump; 6, oil reservoir; 7, air supply; 8, air filter; 9, air-reducing valves. Below is a section of the machine as seen from the front showing the template, 10; the stylus, 11; the work, 12; and the hand controls, 13.

contoured reamers. The unit operates on the same principle as the precision air-measuring gauge, except that the air flow is regulated by the position of a tracer or stylus instead of by the size of the piece being measured. In both cases the rate of flow indicates measurement.

The compressed-air system is governed by the movement of the tracer over a thin metal template and controls the hydraulic system which, in turn, positions the cutting tool. Air is supplied to the system from a constant-pressure source through an orifice of a size that maintains a loading pressure of 35 pounds when the tracer is in "neutral." The air loading pressure is an index of the accuracy with which the work is being done and is visible on an indicating gauge. As long as this instrument registers around neutral loading pressure, the operator knows that the cutting tool is working with accuracy. But if this pressure varies 2 pounds either way, he knows that an error of 0.001 inch has been introduced and that he must adjust his rate of feed.

In the accompanying schematic drawing, the Contour Control is shown as applied to a 12-inch Hendey lathe. As the spring-loaded tracer follows the template, variations in contour increase or decrease the air loading pressure by changing the rate of flow from the air pilot nozzle, thus transmitting the movement of the stylus to the longitudinal or cross slides of the lathe through the medium of the hydraulic control system. Motion of the hydraulic pilot is from 25 to 100 times greater than that of the tracer, depending upon the power of the springs in the hydraulic pilot-valve assembly. With a fully balanced air-pilot valve, the stylus exerts a force of from 3 to 8 ounces only, thus making it possible to employ a soft-metal template.

The Bailey Contour Control was originally developed for use in the company's own machine shop which makes flow-meter parts that must precisely match the contours of specially calibrated master parts. It is in the form of a compact attachment and is being utilized today in connection with lathes and vertical boring mills, although its application is not limited to these machine tools. Contours may include slow and fast tapers, round corners, and square shoulders. In the case of a step shaft, for example, all diameters and shoulders may be turned with one setting of the tool. The unit makes it possible, with unskilled labor it is claimed, to rough out and at the same time finish work within dimensional limits of 0.0002 inch and with a smoothness of 60 microinches—in short, turn out parts that are faithful reproductions of the patterns.

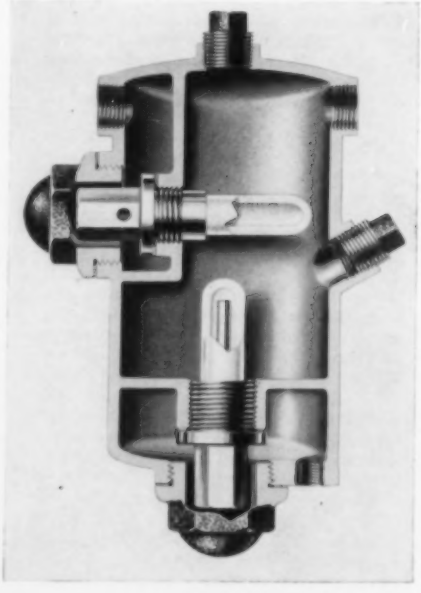
Air-Line Separator Operates on New Principle

A SEPARATOR for removing moisture from compressed-air or gas lines that operates on an entirely new principle has been introduced by the Selas Corporation of America. Known as the Liqui-jector, the device depends upon two porous ceramic tubes for its functioning and contains no baffles or moving parts. One of the tubes permits air (or gas) to pass through it but strips out the water, which then passes through the second tube and automatically drains to atmosphere.

Separation is accomplished by virtue of the surface tension of the liquid. The tube that permits the air to pass through but rejects the water has an average of 50,000 pore openings per square inch, the largest of which have diameters of less than four-thousandths of an inch. They are so small that the pressure drop across the tube is insufficient to permit the passage of water against the resisting diaphragm action of its surface tension. The moisture therefore coalesces on the tube and drops to the bottom of the unit. The second or ejection tube has previously been primed by partly filling the receptacle with water before placing it in service. When compressed air is turned on, some of this water is forced into the pores of the second tube which number 720 million to the square inch. As water drops down from the first tube it is drawn into the pores of the second tube by capillary attraction, or wick action. The water seals the pores of the tube and prevents air from passing through. Within the hollow center of the bottom tube is another tube that carries off the water. There are no drain cocks, traps, or shut-offs. In addition to taking out water, the device will catch dirt and other extraneous solids that are too large to pass through the pores of the first tube. Accumulations of this kind are removed by periodically cleaning the unit.

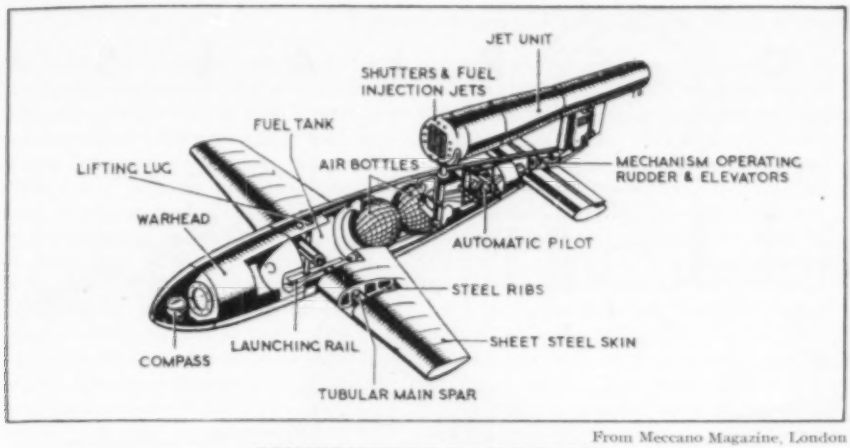
The Liqui-jector has so far been developed for air or gas lines up to 1¼ inch in size and for pressures up to 100 pounds. The maximum rate of water ejection is 2.4 gallons in 24 hours. These units are placed in compressed-air delivery lines close to the points where the air is to be applied. Removal of moisture prevents washing lubricant out of tools and machines, thereby improving their performance and allaying corrosion. Such moisture reduction is vital in the case of air-actuated control systems, and there are instances where air is used for agitation or other process work in which it is important that it be uncontaminated.

The principle exemplified in the Liqui-jector can also be utilized to separate immiscible liquids such as water and gasoline, and the Selas Corporation is developing units for such services.



HOW IT WORKS

At the top is a cutaway view of the interior of the Liqui-jector. Air comes in at the upper right, and passes through the pore openings in the horizontal porcelain tube, thence into the passageway at the upper left, and out through the pipe connection at its top. This tube repels moisture, which forms drops that fall to the bottom of the unit. The water is absorbed by capillary attraction through the pores of the vertical ceramic tube at the bottom, and drains out through the overflow tube inside of it. No air escapes. The plug at midright is unscrewed to add water to the unit for priming the water-ejection tube before compressed air is turned on. At the left is a Liqui-jector incorporated in an air line.



From Meccano Magazine, London

CONSTRUCTION OF THE BOMB

The jet-propulsion unit mounted at the rear of the plane has an air intake at the front in which there is a multiple flap valve. Behind the valve are the fuel jets, and farther back a Venturi with a spark plug at its narrowest point. The fuel is delivered to the jets by compressed air, and at the same time the forward speed of the plane opens the flap valve and allows air to come in. The mixture of fuel and air is compressed in the Venturi and ignited by the spark plug. The resultant explosion closes the flap valve, and all the gases are forced out of the rear end of the jet unit, thereby propelling the craft forward. As the pressure decreases, the valve in front again opens and the sequence is repeated.

HITLER'S FLYING BOMBS

THE German robot flying bombs that harassed London throughout the summer carried bottles of compressed air that served the dual purpose of actuating gyro compasses to keep them on their course and of forcing gasoline into the jet-propulsion engines. In some instances, compressed-air catapults also launched the bombs from their take-off platforms. Officially designated by the Germans as reprisal weapon V-1 and called the "doodlebug" by R.A.F. airmen, the bomb is essentially a small steel airplane with a jet engine mounted above the fuselage and a 2000-pound charge of explosive in its nose. It has a wing span of 16 feet, is about 25½ feet long, and attains a maximum speed of 350 to 400 miles per hour. An accompanying drawing shows its internal arrangement.

Each bomb carries 130 gallons of low-octane gasoline, which gives it a range of around 150 miles. A rudder is set in the direction of the objective prior to the take-off and controlled during flight by the gyroscope compass. As there is no other means of guiding the robot, it is a rather inaccurate projectile, and the Germans soon learned that the chances of its hitting a target were remote unless a large community such as London was selected. One account states that the weapon flies until its fuel is exhausted; another one reports that the engine is cut off by a clockwork mechanism that is set to run for a predetermined period.

The bombs that came in over London were observed to act in three distinct ways. In some cases, when the engine ceased functioning, the wing elevators were depressed and the robot dived earthward. In others the elevators were not depressed and the bomb glided on for some miles before it lost momentum and crashed. Occasionally, the engine was not cut off, but the elevators were depressed and the projectile dived, under power, at terrific speed.

The first of the launching sites consisted of as many as fourteen reinforced-concrete buildings. These were easily spotted by Allied airmen and bombed into uselessness. Thereupon the Germans adopted a simpler layout that could be camouflaged effectively. The launching platform itself consisted of two parallel railroad rails that were spaced about 12 feet apart, extended for some 70 feet, and curved upward at the ends. Where compressed-air catapults were not employed, the bombs were sent on their way by jets or rockets.

Although the V-1 did considerable damage, it never influenced the course of the war. On September 7, Duncan Sandys, chairman of the British Flying Bomb Counter-Measures Committee, announced that the bombardment of London by the robots was believed to be virtually ended and gave figures on their effectiveness. From June 12 to September 7, a total of 8000 bombs was launched of which 2300, or 29 percent, actually reached London. Twenty-five percent went wide of the city and 46 percent were brought down before they reached it. In the week ended September 7 only 9 percent found their mark, and on August 28 only four out of 101 fell in the city.

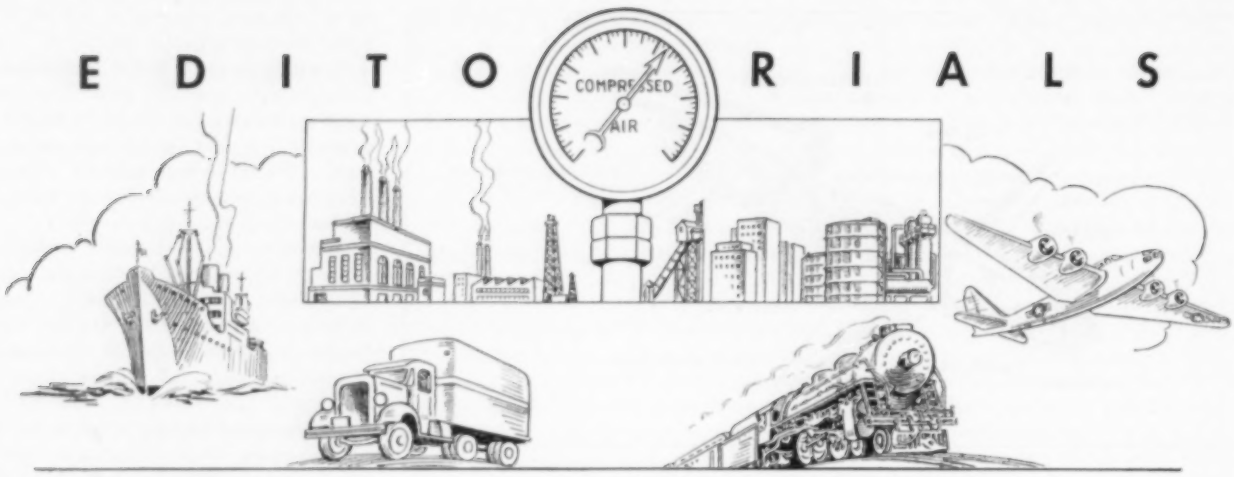
It has been revealed that British secret agents reported as early as April, 1943, that preparations were being made for the bombings, so plans for countermeasures were immediately drawn. Many of London's antiaircraft guns were moved nearer the coast and their number was increased to 2800. They downed a total of 1560 robots, while fast airplanes bagged 1900 and the network of 2000 barrage balloons stopped 15 percent of those that eluded other defenses. Meanwhile, Allied planes dropped more than 100,000 tons of bombs on the launching sites, putting many of them out of commission.

READY FOR LAUNCHING

This photograph, obtained through a neutral source, shows a service crew preparing a robot bomb for launching by means of a compressed-air catapult. The picture appeared in a Munich newspaper on August 10.

Acme Photo

EDITORIALS



ROCKBURST RESEARCH

ONE of the serious problems of deep mining is rockbursts. At depths of around 4000 feet, pressure is so great that sections of hanging walls or of pillars are on occasions violently detached, sometimes literally exploding. The incidence and severity of the manifestation varies according to the structural conditions of the rock, and there are some deep mines that are not affected.

In the Kolar Mine of India, rockbursts are experienced below the 5000-foot level when 60 per cent of the vein material is extracted, according to Peele's *Mining Engineers' Handbook*. The same source states that on the Rand, in South Africa, rockbursts killed 193 men and injured 498 during the period from 1918 to 1924. Remedies seem to vary with the geology of the region concerned. Measures that are effective in one location are often of no value in another. On the Rand, so it is reported, leaving pillars to support the overlying weight is now believed to promote rather than to prevent bursts.

The important thing, of course, is to determine how to detect the imminence of a burst in order that men and equipment can be moved from the area concerned until the danger is past. At the Lake Shore Mine in Canada, where bursts have been rather frequent, a great amount of research has been done along this line since 1941. Using equipment developed by Dr. L. A. Obert of the U. S. Bureau of Mines, the experiments seemed to indicate that subaudible noises are made by minute snapping of the rock when it begins to approach the critical pressure. By means of a sonic device it was possible to record these sounds. Early investigators had apparently demonstrated that when these snappings attained a frequency of around 100 a minute a burst could soon be expected.

The promise that these experiments held forth has, however, not been fulfilled. In the annual report of Lake Shore Mines, Ltd., for 1943, there appears the following paragraph, written by Managing Director A. L. Blomfield: "Research work directed towards the development of equipment for the prediction of the time of occurrence of a burst was continued during the year with disappointing results. In spite of an intensive program of investigation, it has not been determined that pre-burst activity, which might serve as a warning of the impending burst, actually occurs."

Although this is unfortunate, it is by no means discouraging. It merely means that a different tack must be taken, and the mining industry and various governmental agencies may be depended upon to attack the problem with new vigor. As the mines of the world go continually deeper, this problem, as well as those of ventilation and cooling, must be solved.

Preventive measures against bursts are being taken wherever they are possible, and considerable progress is being registered, although, as previously pointed out, there is no universal remedy. In the case of Lake Shore, the report referred to states that there was a gratifying decrease in severe bursting in 1943. Only one heavy burst was recorded, and it occurred in old workings away from current stoping operations.

VITAMINS FROM THE SEA

ONCE considered worthless, and despised by commercial fishermen because of the damage it did to their nets and gear, the common dogfish has become a marine product of some importance. Its changed status dates from 1927, when it was discovered that dogfish-liver oil contains vitamin A five to ten times as great in potency as that of standard pharmaceutical cod-liver oil. The vitamin value in the Pacific dogfish is higher than that in the Atlantic species, and the former consequently commands a better price and is more eagerly sought. In British Columbia, where twelve kinds of fish liver were marketed last year, dogfish liver led the list, with 5,100,000 pounds yielding the fishermen $1,345,000. This was an average of nearly 27 cents a pound. The price has varied erratically in recent years, having risen from five cents in 1941 to a recent quotation of 38 cents in British Columbia and up to 67 cents in Seattle. The oil from the British Columbia catch in 1943 had a market value of $2,030,000.

The dogfish is one of the smaller varieties of shark and is so named because of its habit of hunting smaller fishes in packs or schools. One species attains a length of 4 or 5 feet, while another rarely exceeds 30 inches. While generally considered inedible, certain kinds are eaten to some extent on the west coast of England and more generally in France. Although unwanted, some dogfish have always found their way into fishermen's nets in British Columbia waters and have been converted into oil and fertilizer. The oil was rendered as long ago as half a century and served as a lubricant for machinery in sawmills and other industrial plants. It was not until 1934 that it entered pharmaceutical trade channels, although feedmills began to use it two years earlier for fortifying other fish oils in making stock and poultry feed. Although high in vitamin A content, dogfish-liver oil is low in vitamin D, and it is for this reason that it is frequently blended with an oil high in vitamin D to obtain an end product containing both in desirable quantities. Liver makes up from 10 to 20 percent of the weight of a dogfish and yields from 30 to 80 percent oil, by weight.

In addition to dogfish livers, British Columbia fishermen market livers from halibut, ling cod, black cod, red cod, gray cod, soupfin sharks, mud sharks, ratfish, skates, salmon, and bass. Soupfin-shark-liver oil is the richest of all in vitamin A, and livers are bought on the basis of this potency, which explains the widely fluctuating price. The 1940 price in Seattle ranged from 30 cents to $1 a pound. Since then, they have sold all the way from $1 to $6 a pound. Three-fourths of the vitamin A yield in the United States in 1943 came from shark livers.

Foundryman Uses "Lost Wax Process"

IN CASTING complicated parts for turbo-superchargers that have measurably lifted the airplane ceiling we have adapted what is known as the "lost wax process." It was described by Benvenuto Cellini, the famous sixteenth-century artist in metals, and was used in founding bronze and other metals of low melting point. Dental laboratories were the first to apply the method to high-melting-point alloys that retain their strength and hardness at high temperatures, and further developments in the General Electric Research Laboratory led to its use in the making primarily of buckets for gas turbines that drive superchargers.

The first modification of the so-called lost process necessitated forming a wax pattern, precise in every detail, by hand. This was encased in a plaster mold that could be heated after hardening to melt out the wax. The cavity was then filled with a soft metal such as lead, brass, copper, gold, etc., and after it had set, the plaster was broken loose. The casting was an exact replica of the wax pattern. So far as it went, the procedure was all right, but plaster does not stand up under the high temperatures required to melt iron, steel, and the new hard alloys. The laboratories then developed mold materials for metals with melting points of 3000°F. and more. In addition, General Electric designed electrically controlled machines for the quantity production of identical wax patterns.

By the latest method, a metal master pattern is made of the part to be cast, and this, in turn, serves to form a split lead-alloy mold. The latter is provided with dowel pins for accurate mating and may be divided into a number of pieces, or fitted with inserts, if the part to be produced is a complicated one. Properly clamped together, the mold goes into a machine in which it is held under a partial vacuum and which injects the molten wax into the cavity or cavities under air pressure. By this vacuum-pressure system the fluid flows freely and fills every void in the mold. When the wax pattern is removed after cooling, it may be combined with others by heating the faces to be joined, thus providing an intricate pattern that it would be difficult to fashion in any other way.

The next step is to dip the wax pattern into a liquid binder carrying fine silica sand in suspension. When this coating has hardened, the pattern is put in a metal container in which the finished mold is made. This is done simply by pouring a mixture of graded silica sand and a binder around the pattern and allowing the material to set. At that stage the mold is placed upside down in an oven and subjected to a temperature of 250°F. to melt the wax so it will run out. All that is then needed to prepare the mold for the teeming operation is to heat it to about 1650° so that the molten metal poured into it will remain fluid and reach all interstices. Casting is done variously. In one foundry the metal may be injected with compressed air, and in another centrifugal force may be used to the same end. The final work, after a sufficient cooling period has elapsed, is to break the mold and to remove the casting.

Automatic Hardness Tester and Stamper

WITH the aid of scrap collected here and there in The Glenn L. Martin Company airplane plant, one of its Army Division inspectors has built a mechanical device that tests sheet-metal parts for hardness and, if they meet requirements, stamps them automatically. Within a period of eleven months, an estimated three million pieces have passed through the machine at a saving in time of 1050 man-hours, or 1¼ seconds per part, over former methods. With the customary hand tester, the operator has to read a dial to get the result, and then take a hammer and die and mark each piece with his personal stamp and the heat-treat stamp. With the Hardness Certifier, the work is entirely mechanical and can be performed even by a blind person with no chance of error once the apparatus is set for the thickness of the material and for the minimum satisfactory hardness.

The testing unit proper with its indenter point and guard is of the conventional type and is mounted, together with the stamping mechanism and a motor, on a flat-topped base on which the parts to be tested are placed. The stamping mechanism consists of a solenoid-operated plunger. The indenter point is raised and lowered electrically 43 times a minute, which has been found to be the most satisfactory rate. However, the machine can be geared to move faster or slower. If the metal measures up to the hardness for which the certifier is set, contacts are closed and the plunger automatically stamps it both for hardness and with the inspector's identifying mark. But if the material is too soft, the contacts do not close and the plunger remains inactive—the part cannot possibly be stamped under that condition. This also applies should the indenter point accidentally break. The testing unit can be easily removed to replace a broken point. Several new machines have been built for the Martin plant, and the York Electric Tool Company has been licensed to produce the Hardness Certifier for general use.

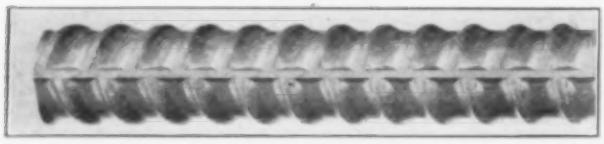
WORKS AUTOMATICALLY

The Martin Hardness Certifier and its inventor, Adolph Vlcek, Jr., inspector, Army Division. The machine both tests and stamps sheet-metal parts mechanically and eliminates error through mistaken reading. The bracket supporting the testing unit and the motor that operates it can be raised and lowered by means of a screw and crank. The arm extending from the upright supports the plunger with its removable stamps.

Industrial Notes

In the first year of its operation, the Big Inch pipe line has conveyed 19,292,000 barrels of crude oil from the Texas fields to eastern refineries. During the month of July, the daily average delivery was about 5 percent above the rated capacity.

What is described as a revolutionary type of concrete reinforcing bar has been announced by the Inland Steel Company. It is named Hi-Bond and is designed to give the greatest possible bonding value between concrete and steel. This is accomplished by means of reversed, double helical ribs that extend



between diametrically opposed longitudinal ribs. The bar is said to bend well, to have more than double the bearing area of the usual commercial types of reinforcing steel, and to provide a more effective mechanical grip irrespective of its position in the concrete or the direction in which it is pulled. It is produced in nine standard sizes having an area from 0.11 to 1.56 square inches and ranging in weight from 0.376 to 5.313 pounds per linear foot.

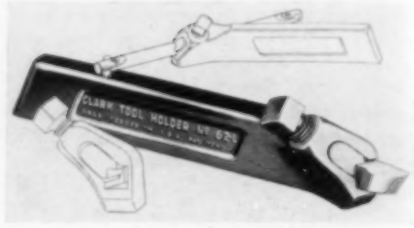
Chrysler Corporation, maker of oil-impregnated, powdered-bronze bearings, has announced that it is extending its line of Oilite products. It is manufacturing 20x30x1-inch thrust plates and is ready to supply bushings up to 18 inches in diameter and, where design and quantity permit, 36 inches and more in size. It is also studying the possibility of providing a 6-inch bar with a 2½-inch hole in 13-foot lengths.

The Joseph Dixon Crucible Company has taken a leaf out of the book of cosmetic makers and is putting out a lubricant in stick form named Slipstick. It is contained in a cylinder 3 inches long and ⅞ inch in diameter, with a disk at each end to push it out and in again. The compound is an admixture of high-grade flaky graphite and other lubricants and adheres lastingly, it is claimed, to any soft or hard material. It has numerous industrial, office, and home applications such as preventing doors, windows, and drawers from sticking.

Something new in portable fire extinguishers for use against burning oil, gasoline, and electric equipment is being offered by the National Powder Extinguisher Corporation. It consists of a main cylinder containing a powder that is directed against the base of the flames by compressed gas in a small connecting cylinder. Upon contact with heat, the powder forms a gas that blankets and smothers the fire. The main cylinder is recharged when empty and the pressure cylinder and valve are replaced as a unit. The extinguishing material is said to be harmless to the operator and equipment.

For use instead of metal and plastic name and instruction plates on machinery, the T. J. Smith Lithographing Company, Ltd., has a label of plastic-impregnated paper backed by an adhesive that is moistened with a solvent for application. When dry, the bond with the metal surface is said to be such that the label remains in place in temperatures ranging from −50 to 150°F. and after immersion in fresh or salt water for 96 hours.

Adaptability is the feature of a new tool holder that has been put on the market by the Robert H. Clark Company for use in connection with lathes, shapers, and planers. According to the manufacturer, it is adjusted by means of a set screw and takes any one of four or more tool bits of different shapes and sizes. A special vise-like jaw clamp holds the bit vertically and horizontally with a grip that is evenly distributed throughout the entire holder channel, in that way greatly reducing bit breakage occasioned through screw contact at a single point. Square, round, out-of-round, or dual narrow bits for cutting-off or forming operations are all held equally rigid, as well as very short bits that normally have to be scrapped. Two types are available—the 15° sloping-channel model and the horizontal- or parallel-channel



TWO TYPES

Reproduction of the sloping channel holder with line drawings showing its vise-grip end (bottom) and the horizontal- or parallel-channel model (top). The latter takes both square and round tools for outside and inside threading operations and for boring. Both types are suitable for use with extra-hard cast-alloy tool bits.

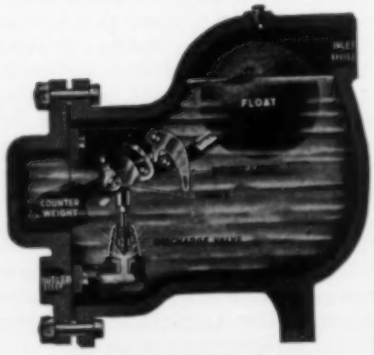
model in either right- or left-hand offset. Each comes in several shank sizes, with heads shaped and positioned so as to give an unobstructed view of the tool-bit cutting edge.

Sturtevant has announced a new torque wrench that is distinguished from the former models in two particulars. In addition to giving visual reading when the release point is reached, the operator is made conscious of that fact by

4 BIG REASONS

WHY THIS TRAP IS AMERICA'S No. 1 TROUBLE SHOOTER for AIR SYSTEMS

Intermittent Discharge
★
Large Capacity
★
Welded Stainless Steel Float
★
Water Sealed Discharge Valve



THE NICHOLSON MODEL "JR" COMPRESSED AIR TRAP is being adopted as "standard" in more and more plants, for automatically draining water and oil from compressed air separators, after-coolers, receivers, etc. For air, gas, and saturated steam pressures up to 200 lbs. Made in one pattern size only, with either ½", ¾" or 1" inlet, and ½" outlet. Bulletin No. 341.

W. H. NICHOLSON & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

Improved AFTER COOLING METHOD

DRIES COMPRESSED AIR MORE THOROUGHLY

and Saves Cooling Water Costs

U. S. Patent Re-issue No. 22,533

"BALANCED WET BULB" TEMPERATURE CONTROL

EXTRA DRYNESS is vital to industrial users of compressed air, as in spraying protective coatings or in using air to clean fine instrument parts. And you protect all air tools, grinders, hammers, riveters—from water damage, from freezing and from loss of lubrication when the air is thoroughly dried in the NIAGARA Aero AFTER-COOLER.

Obtaining lower temperatures than with ordinary after-cooling, the NIAGARA Aero AFTER-COOLER produces air that is far drier. An *evaporative* cooler, it does not consume water, but repays its cost by eliminating water bills. It also provides controlled temperature for jacket and intercooler water with the Niagara "Balanced Wet Bulb" control which automatically assures the correct admixture of fresh outdoor air with recirculated air.

Write for Bulletin 96 and 98

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

Dept. CA-104, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

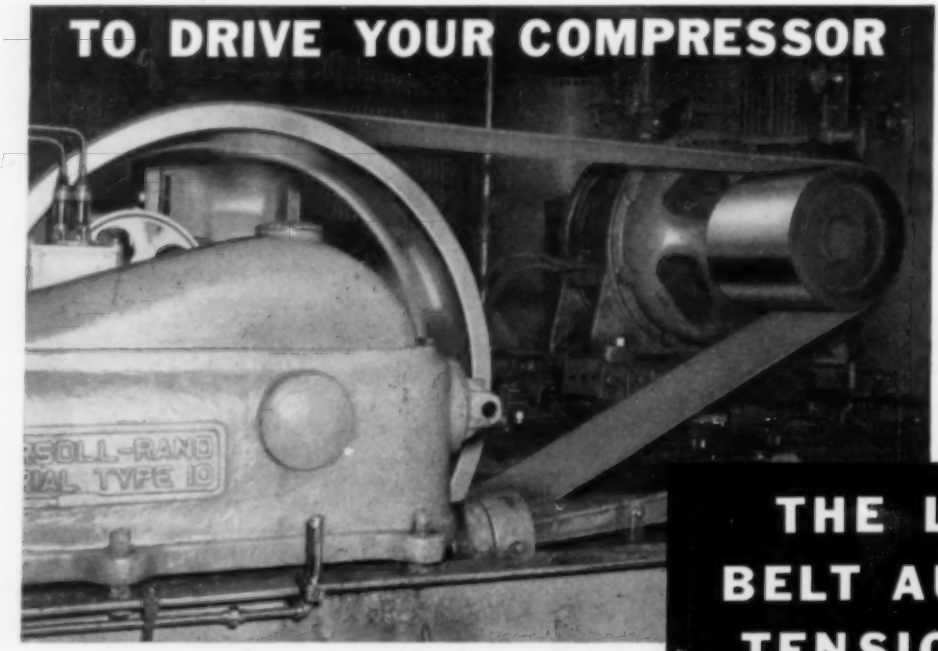
both sound and feel. Hence the name Sensory Torque Wrench. The tool has a trigger finger that can be set to sound a signal when the desired torque has been applied. When that point is reached there is a distinct click, and a strong impulse is imparted to the operator's hand, causing him to release his pull on the wrench through reflex action. This triple indication results in fast work, and the tool is said to remain dead accurate under ordinary shop abuse.

We are informed that leather impregnated with colloidal graphite is converted into a product of surprisingly changed characteristics that is being used as a packing material. The leather takes on a gray luster, great resistance to heat, exposure, and moisture, and shows good electrical conductivity. The graphite acts as a lubricant, and in order that the tiny carbon particles may penetrate and spread uniformly throughout the pores they are dispersed in an olive-oil soap solution that can be applied by dipping or spraying.

Nubun is the trade name of a new synthetic-rubber insulation of laminated construction developed by the United States Rubber Company for power, lighting, and communication cables. It is made of a modified and improved basic buna S polymer in latex form permitting the use of the continuous dip method of production. The nature of the process is such that the rubber particles are not distorted or broken down by milling, and it enables centering the conductor perfectly. The results are an insulation with high resistance to wear and a wire of maximum conductivity and minimum diameter. Among other properties claimed for Nubun are good aging qualities because of the presence of special antioxidants, flexibility, impermeability to water, and high dielectric strength.

Complete with recharging equipment and tester, The B. F. Goodrich Company is offering a wet flashlight battery that is built on the principle of automobile wet storage cells. It can be used in the standard 3- or 5-cell dry battery case with the aid of spacer plugs and takes a special 600-mil Mazda lamp, as compared with the 300-mil bulb of the dry type. In actual wattage, the wet consumes 50 percent more than the dry cell but gives a proportionately brighter light. This is maintained throughout its service period because the voltage drop between a fully charged and a discharged wet battery is only 0.35. It is claimed that a freshly charged unit will give about three hours of constant light and that the wet battery will outlast 400 dry cells. It is sold with a six months' guaranty that authorizes replacement if failure is not due to abuse or misuse.

TO DRIVE YOUR COMPRESSOR



USE

THE LEATHER BELT AUTOMATIC TENSION DRIVE

The Leather Belt Automatic Tension Drive—pivoted motor base and flat leather belt—automatically varies belt tension to match the load. Here are the advantages of this type of drive:

- Easy to figure—easy to install.
- No guesswork about tension.
- No matching of belts.
- Fewer belt take-ups.
- Less maintenance to driving and driven equipment.
- Lower initial cost.
- No frequent pulley replacements.
- Less space required.
- Lower power cost.

To belt this drive use Graton & Knight "Research"

Research leather belting is ideal for compressor drives because:

IT HAS GREAT PLIABILITY AND HIGH COEFFICIENT OF FRICTION.

You benefit because you get maximum pulley grip and most power transmission even with small arc of contact on pulley.

HAS LOW STRETCH. PRESTRETCHING REMOVES ALL NON-ELASTIC STRETCH.

You benefit because the elasticity of Research belt absorbs shock, starting or impulse loads. Less maintenance time and cost.

ITS SPECIAL CURRY RESULTS IN RESISTANCE TO INTERNAL HEAT.

Even when operated at high speed Research gives you longer, more economical belt performance.

GRATON & KNIGHT COMPANY

WORCESTER 4, GRATON AND KNIGHT MASSACHUSETTS

Branches and distributors everywhere. Look under "Graton & Knight" in "Belting" section of classified telephone directory or THOMAS' REGISTER.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

Where flour dust is dynamite

A typical example of B. F. Goodrich development in rubber

FLOUR dust can be highly explosive. When anything that burns is broken into fine particles and mixed with the right amount of air, a single spark can cause an explosion.

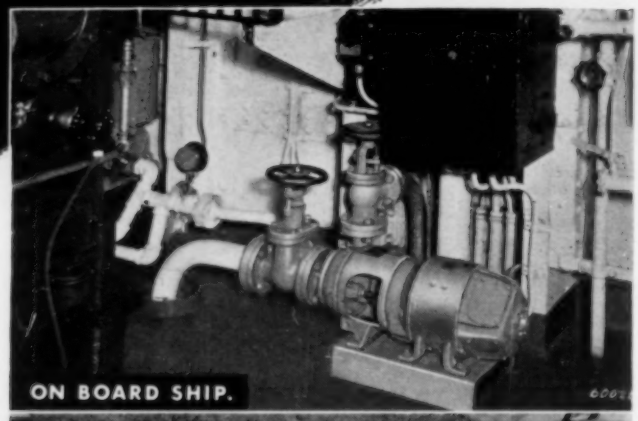
Millers did everything possible to keep out of their plants anything that might cause sparks, but the greatest danger came from belts used to drive their machines. A running belt frequently built up static electricity. Because rubber wouldn't conduct electricity, the current would build up until the charge was strong enough to jump to some conductor — jump *and* spark.

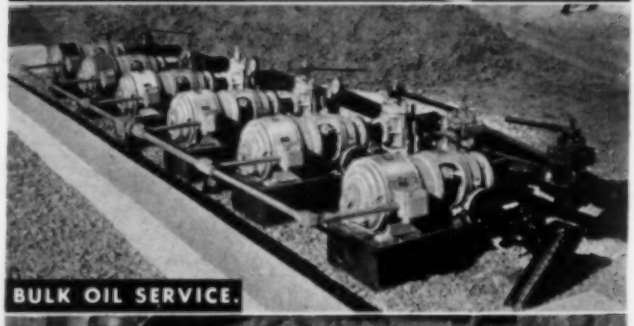
Flour men were afraid of this danger and came to B. F. Goodrich for help. They found that B. F. Goodrich research men had already changed the very nature of rubber by developing a compound that *carries* electricity — the current flows through the rubber and is carried away. Belts made of this material — with *one billion times* the ability of ordinary rubber to carry electricity — have been protecting powder and chemical plants from explosions for several years. Static-conducting belts like those in the picture were installed in the flour mills and immediately ended threats of explosion.

There are many new B. F. Goodrich developments you may not know of that might solve a problem for you. And there have been many improvements in older products. For B. F. Goodrich research is continuous, on old products as well as new. If you have a problem that might be solved by rubber — natural or synthetic — write *The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio.*

B.F. Goodrich

RUBBER *and* SYNTHETIC *products*





Yes, the Motorpump is tough. It will take plenty of punishment and still stay on the job.

That is one of the reasons why it is used wherever liquids must be pumped.

It is available for capacities from 5 to 1800 gal. per min. and heads to 500 ft. Let the Ingersoll-Rand engineer give you complete details. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

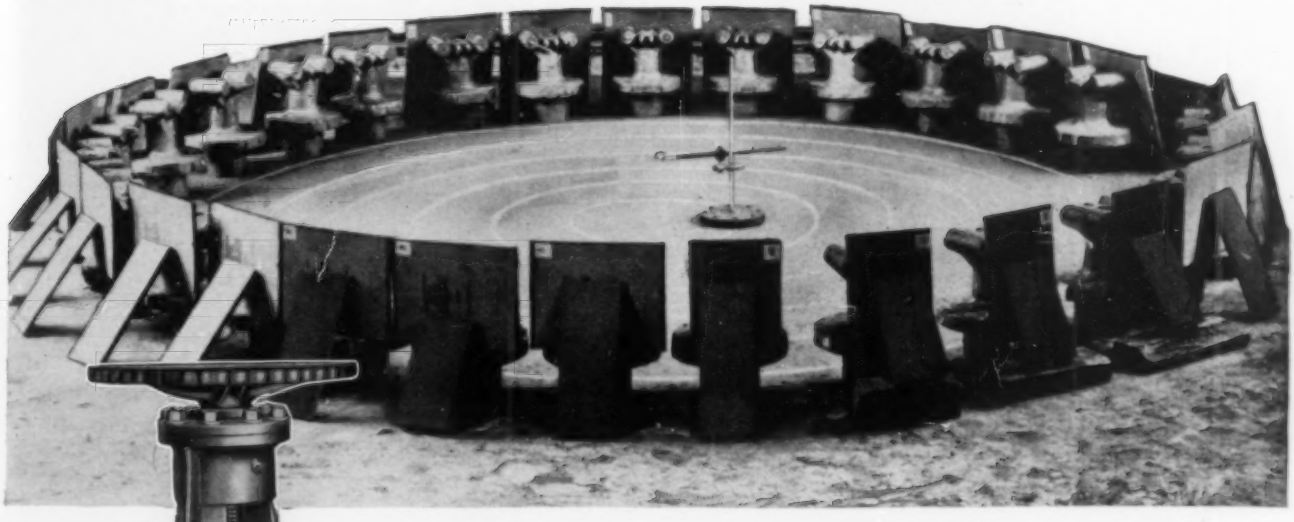
Ingersoll-Rand

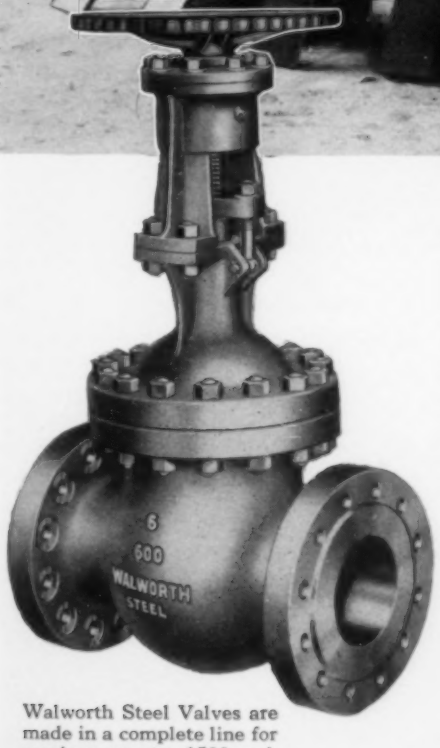
9-522

THIS *INSIDE STORY* TELLS ONE REASON WHY

WALWORTH STEEL VALVES

GIVE LONGER SERVICE





Walworth Steel Valves are made in a complete line for services up to 1500 psi. Steam — 5000 psi. O.W.G.

THE quality of steel castings used for Walworth Steel Valves has an extremely important bearing on valve performance. Here, in this photograph, you see one of the ways in which Walworth high pressure Steel Valves are tested to assure long, dependable service.

This group of bonnets for Walworth Series 600 Steel Valves is being inspected by the gamma-ray method, a technique used by Walworth for many years for the study and improvement of the heavier and varying sections of steel valves and fittings. With the aid of this modern inspection method, Walworth produces castings for Steel Valves that are outstanding in their quality and freedom from hidden defects.

By supplementing this modern inspection technique with progressive manufacturing methods, careful testing of materials, and constant research, Walworth manufactures steel valves and fittings that have earned an outstanding reputation throughout industry for their long, dependable performance in the services for which they are recommended. Walworth catalog 42 describes the complete Walworth line of valves and fittings of steel, iron and bronze. Write on your company letterhead for a free copy.

ARMY-NAVY

BOSTON WORKS
KEWANEE WORKS

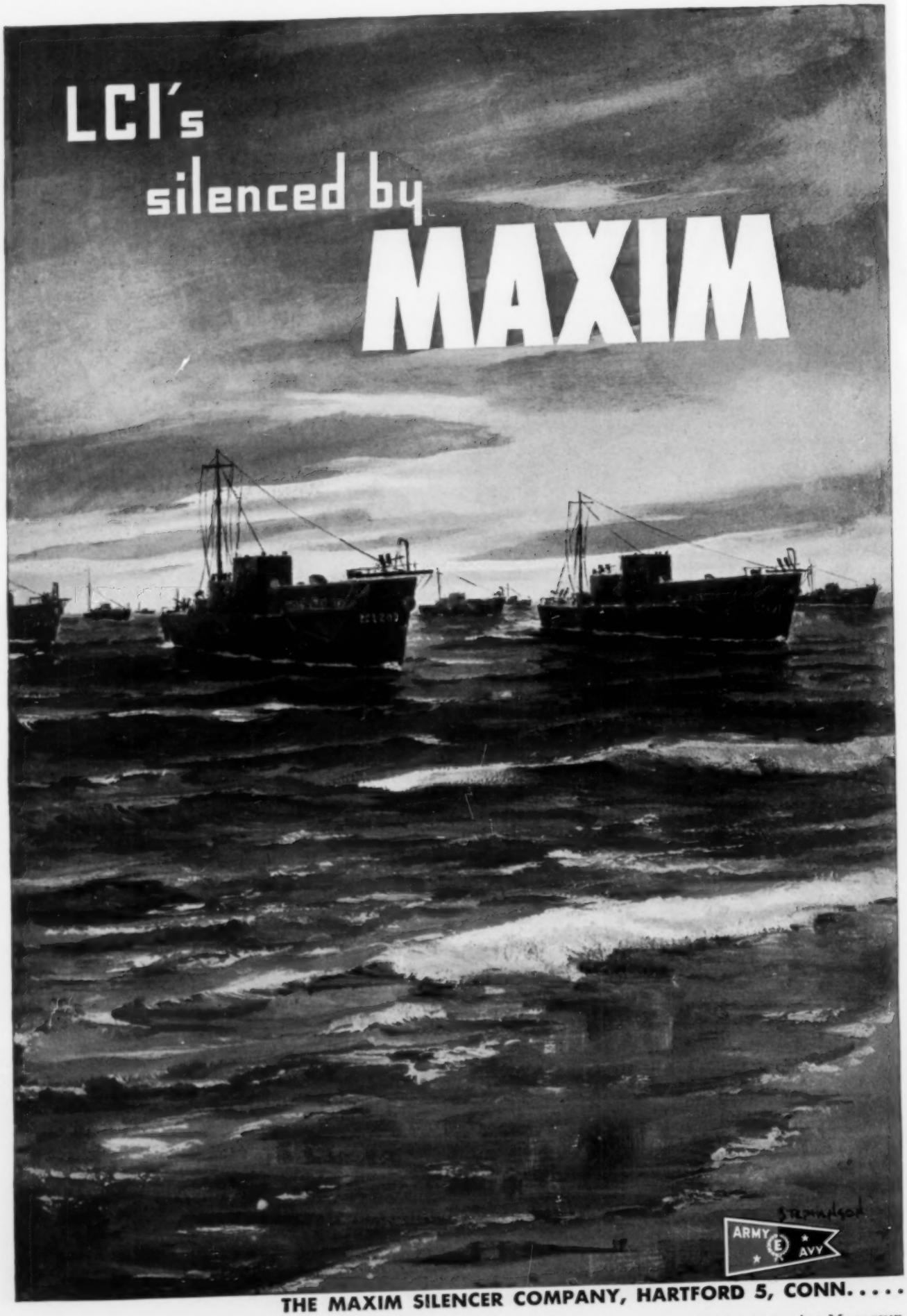
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

WALWORTH VALVES AND FITTINGS ESTABLISHED 1842

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



THE MAXIM SILENCER COMPANY, HARTFORD 5, CONN. . . . .

Because a Jackhamer strikes 2,000 hard blows a minute . . .

SHELL CLAVA OIL KEEPS AIR TOOLS "ON THE GO"

1. Its great film strength assures protection for all moving parts under the most severe operating conditions.
2. Flows freely through the lubricating system at all temperature ranges encountered.
3. Has high wetting ability . . . protects internal drill parts against rust.
4. Does not form "gum," keeps valve action free. Seals pistons effectively.
5. Adheres to metal surfaces, making it possible for a small quantity of oil to do a complete lubrication job over long operating periods.
6. Carbon formation is reduced to a minimum.

NOTE: *To assure adequate lubrication at all times the use of an air-line lubricator is recommended.*

A "LAZY" OIL WON'T DO!

IN order to give trouble-free performance, an air-drill lubricant must do more than just lubricate. It must have all of the characteristics listed in the box at left. Any oil that does less is a "lazy" oil . . . causes costly production delays.

Shell Clava Oil has *all* of the characteristics necessary for reliable air tool performance. That's why operators have found that by using hard-working Shell Clava Oil, air tools stay "on the job" for longer periods of time, prevent excess wear of parts.

Call in the Shell man now. Let him show you how your air tools will serve you with utmost dependability when lubricated with Shell Clava Oil.

SHELL *COMPRESSED AIR* LUBRICANTS

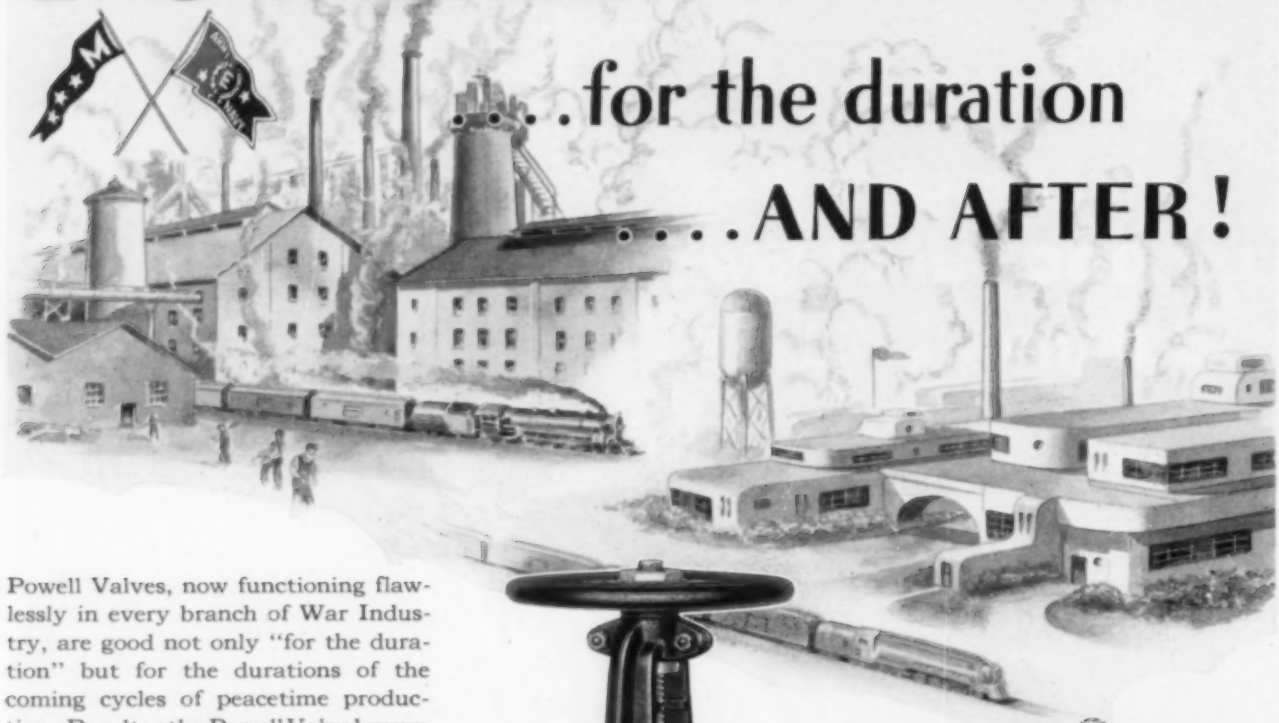
COMPRESSA OIL FOR AIR COMPRESSORS

CLAVA OIL FOR AIR TOOLS

POWELL VALVES

. . . for the duration

. . . AND AFTER!



Powell Valves, now functioning flawlessly in every branch of War Industry, are good not only "for the duration" but for the durations of the coming cycles of peacetime production. Resultantly, Powell Valve buyers need face no scrapped installations when reconversion comes, whether it come by degrees or all at once.

The basic principle of efficient flow control is, at all times, the *right valve*, in the *right spot*, for the *right job*. It is on this principle that the complete POWELL Line of Industrial valves of all types and materials has been developed through nearly a century of successful valve manufacture.

The valves shown here are especially adapted for controlling the flow of compressed air and also of water for cooling air compressors. There's a POWELL Valve to fill every requirement in compressed air service.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

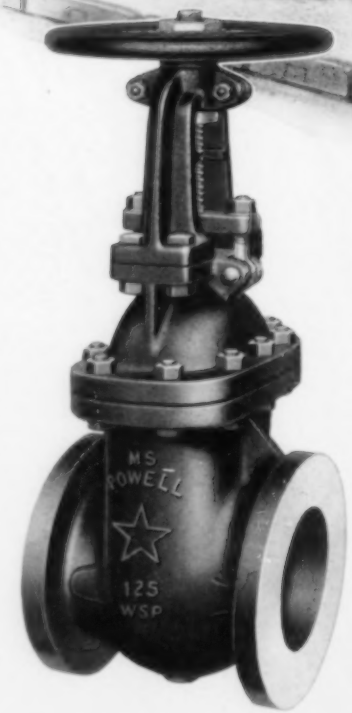


Fig. 1793—Large size Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes, 2″ to 30″, inclusive. Also available with taper wedge double disc.—Fig. 1444.

Fig. 301—Iron Body Bronze Mounted Globe Valve for 125-pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged bonnet, renewable composition disc and renewable bronze seat ring. Sizes, 2″ to 10″, inclusive.

POWELL VALVES

TIGER BRAND has earned its service stripes

OUR ships, planes and mechanized fighting equipment have shown the world what American ingenuity can do when put to the test.

Wire rope, indispensable in the construction and operation of these implements of war, has taken on one unusual assignment after the other. Particularly is this true of American TIGER BRAND.

Not only have our engineers provided the fighting forces with TIGER BRAND to meet exacting requirements, but our shop forces, working around the clock, have turned out wire rope in quantities that would ordinarily have been thought impossible.

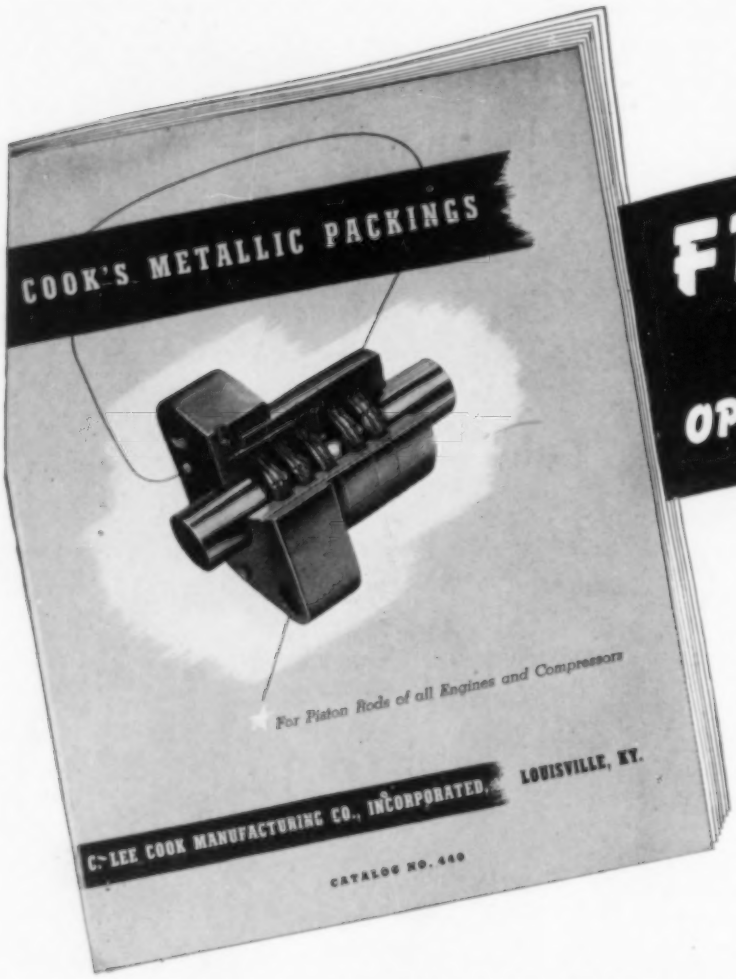
In making TIGER BRAND for war, we have learned two important things—how to turn out high quality wire rope fast, from new and better steels—and how to adapt it successfully to many new uses.

This hard-earned knowledge will insure top efficiency when you apply TIGER BRAND in domestic service. Today, a steadily growing amount of TIGER BRAND is becoming available for use here at home. So, when you need wire rope—and want the best—give us a call.

Excellay Preformed

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL


COOK'S METALLIC PACKINGS
For Piston Rods of all Engines and Compressors
C. LEE COOK MANUFACTURING CO., INCORPORATED, LOUISVILLE, KY.
CATALOG NO. 440

FREE... TO DESIGN AND OPERATING ENGINEERS

Write for your copy on your company letterhead - - or use coupon below

THIS Catalog, just off the press, covers the entire subject of Metallic Rod Packings and the materials of which they are made . . . It gives you complete details and illustrations of a comprehensive line of engine and compressor packings, including the higher pressure packings being used by the *Chemical* and *Petroleum* industries. The material is arranged and indexed to facilitate selection of the correct packing for a particular type of equipment and service . . . Valuable information on packing application and maintenance is also included, together with engineering tables on rod material, gases and other data pertinent to the subject of packings . . . A complimentary copy is yours for the asking if request is made on your company letterhead. If you use the coupon, just pin or paste it to the letterhead.

Sealing Pressures Since 1888

C. LEE COOK MANUFACTURING CO. INCORPORATED

LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

MAIL TODAY
Fill in and attach to your company letterhead

C. LEE COOK MFG. CO. CA-10
76 Beaver St., New York 5, N. Y.

Please send me a free copy of the new Metallic Rod Packings Catalog No. 440

Name: .....Position:.....

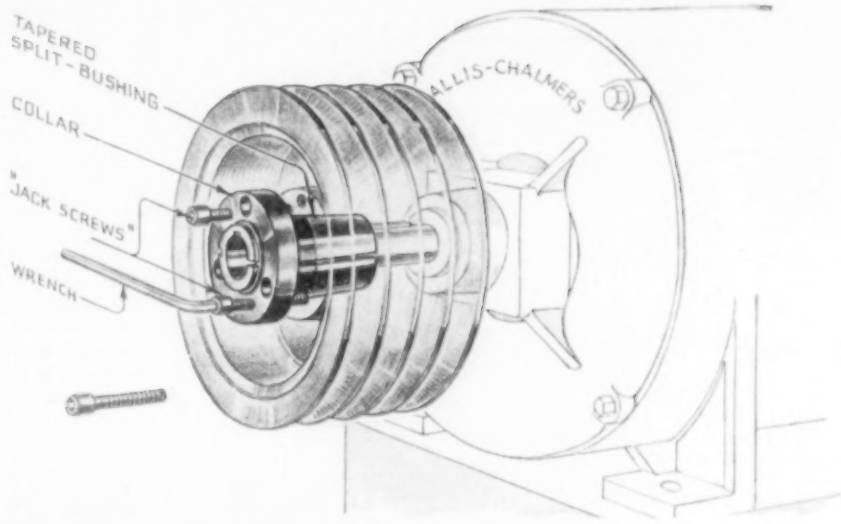
Company .....

Street Address.....

City and Zone Number.....State.....

X-Ray View

OF ALLIS-CHALMERS' NEW "MAGIC-GRIP" SHEAVE



Fastest mounting and demounting sheave on the market, the new "Magic-Grip" costs you nothing extra.

1 **Remove three capscrews** from bushing collar. A handy wrench — supplied with each sheave — is the only tool needed to remove Allis-Chalmers' new "Magic-Grip" from motor or machine shaft quickly and easily.

2 **Insert two capscrews** in tapped holes. As screws are turned, they become levers . . . automatically breaking tight grip of tapered split bushing on sheave and shaft. Entire unit is then ready for removal.

3 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off . . . smoothly, quickly. *It costs nothing extra!* Send for B6310. Allis-Chalmers, Milwaukee 1, Wis.

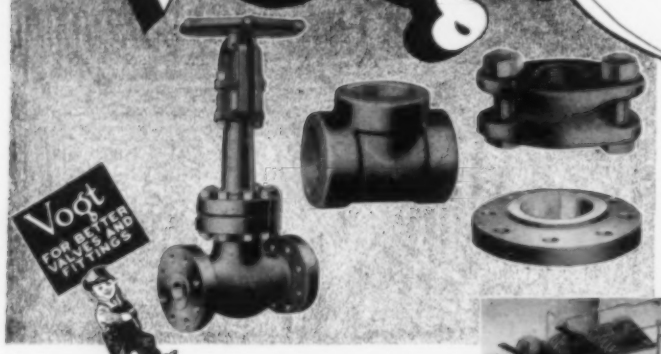
A 1770

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

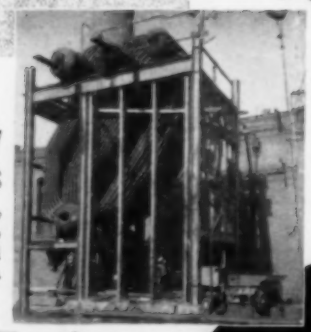
Vogt PRODUCTS ARE

★ DESIGNED to RAISE
★ OPERATING STANDARDS and
★ LOWER YOUR COSTS



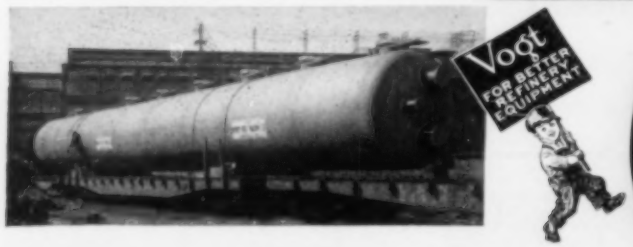
Drop Forged for Safety and Economy under the Most Trying Conditions

Valves, Fittings and Flanges by Vogt—the choice of operating men everywhere for safe and sure regulation of the high pressure and high temperature liquids and gases used in modern process work.



High Operating Efficiencies and Low Maintenance Costs

More steam per dollar of investment—because Vogt steam generating equipment is designed and built to fit in with specific operating conditions. Vogt boilers are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuels, as desired. Three-drum types can be supplied to fit any conditions of restricted installation space.



Meeting the Demands for Operating Security

Vogt has every facility for the fabrication of stills, towers, continuous rotary filters, filter presses, oil chilling machines, heat exchangers, etc., and these products are serving the petroleum industry around the world.

Vogt PRODUCTS

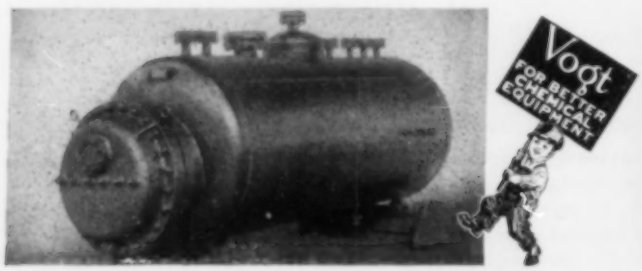
For Oil Refineries, Chemical Plants, Power Plants and Related Industries

☆

HENRY VOGT MACHINE CO.

LOUISVILLE, KENTUCKY

NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS



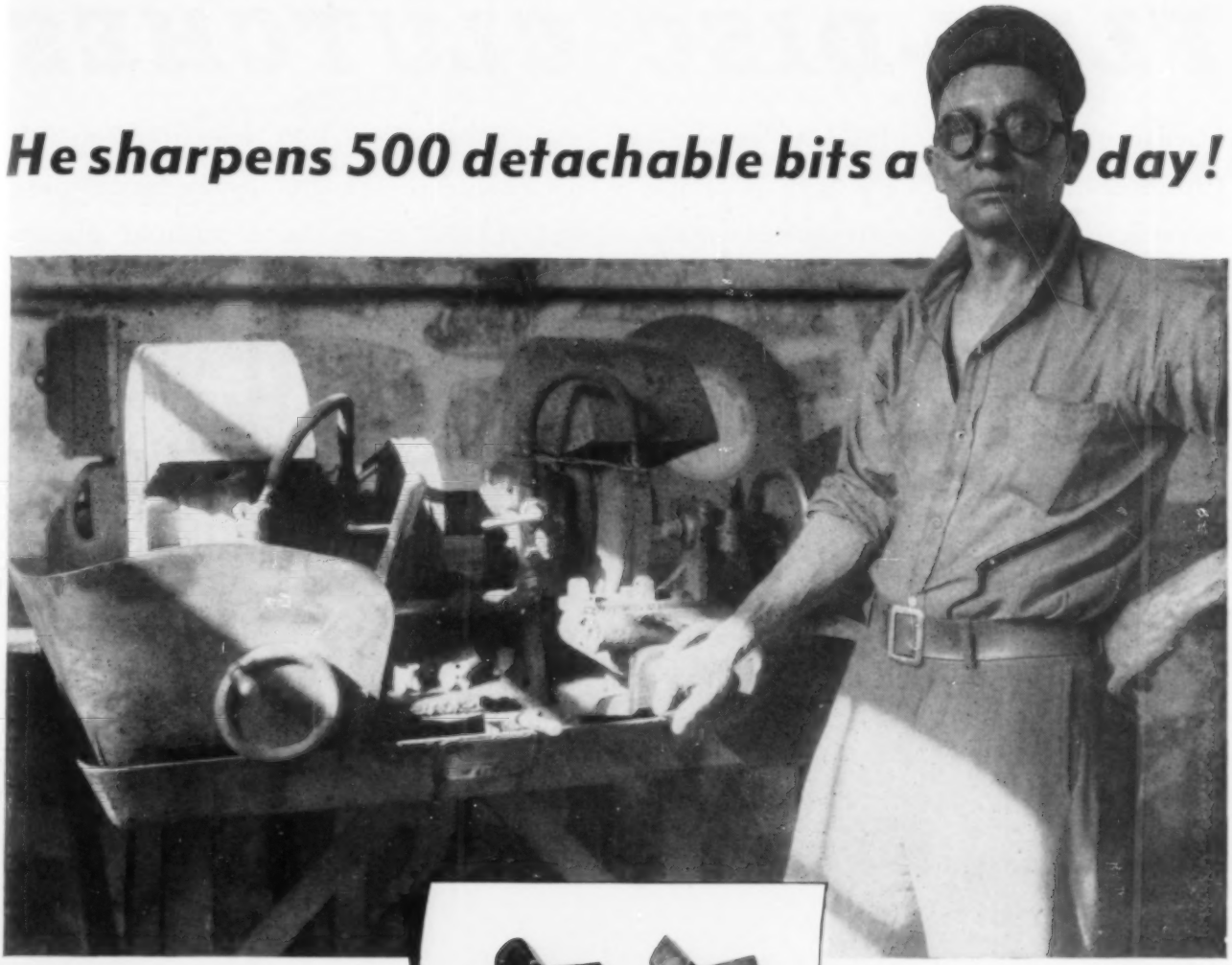
To Combat Corrosion and Product Contamination

Process equipment made from special metals and alloys for the exacting service of the chemical plant is fabricated in our modern shops for many of the well known chemical companies.

Steps Tonnage Up and Costs Down

Our experience of more than 50 years in building profit-making ice and refrigerating machinery is at your command. We make complete units for ice and cold storage plants, packing plants, dairies, breweries, chemical plants, oil refineries, etc.

He sharpens 500 detachable bits a[illegible] day!



BEFORE GRINDING AFTER GRINDING

That sounds like a mighty big order, but the job is done every day by grinders who use *Aloxite* Wheels by Carborundum. In order to receive the maximum efficiency and production from detachable bits, it's necessary to get and *keep* a good cutting edge on them. These grinding wheels cut free and cool, and preserve the temper of the steel, so the bits can remain in service for longer periods.

Detachable bits reduce steel shop costs and nipping charges, and eliminate the need for taking steel in and out of working spaces. So you save time and labor, speed production, and cut drilling costs when you keep your detachable bits properly ground with Grinding Wheels by Carborundum.

The Carborundum Company, Niagara Falls, New York.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Buffalo, Pittsburgh, Cincinnati, St. Louis, Grand Rapids

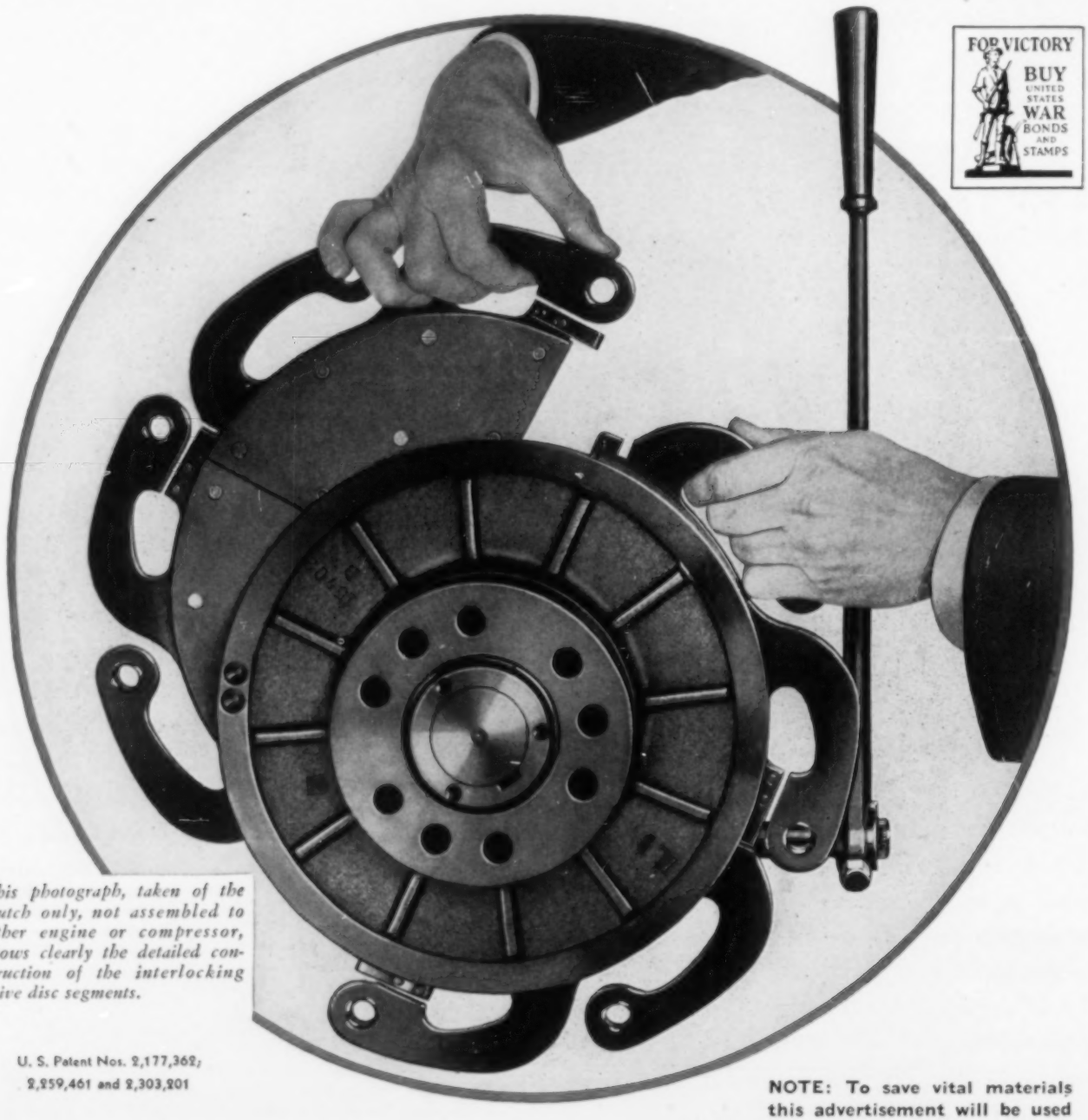
Grinding Wheels by CARBORUNDUM

TRADE MARK

(Carborundum and Aloxite are registered trade marks of and indicate manufacture by The Carborundum Company)

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

WHY YOU CAN'T SEE THE AIR

in the dining car . . .

Conditioning the air in modern railroad cars is a tough job. It calls for first rate engineering of heating, cooling, humidifying and particularly of air cleaning devices for use with fresh air intakes as well as with recirculated air.

Filters in these cars must be able to handle almost every conceivable type of dust, lint and dirt. A large percentage of these are made by Air-Maze, who offer filters of special design—one for fresh air and others for recirculated air.

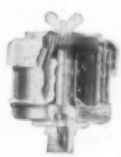
Preference for Air-Maze filters, not only in railroading but in dozens of other fields, is due to the fact that Air-Maze engineers co-operate closely with others who make control of air an exact science. Knowing the problems, and with the experience of nearly 20 years to draw upon, they have been able, time and time again, to solve the most difficult filtration problems.

Wherever clean air can remove a nuisance of health hazard or improve the quality of your product or service, consult Air-Maze *first*.

Air-Maze Filters *Fit* The Job

Typical ventilating panel filter.

Engine intake air filter. Oil bath type.



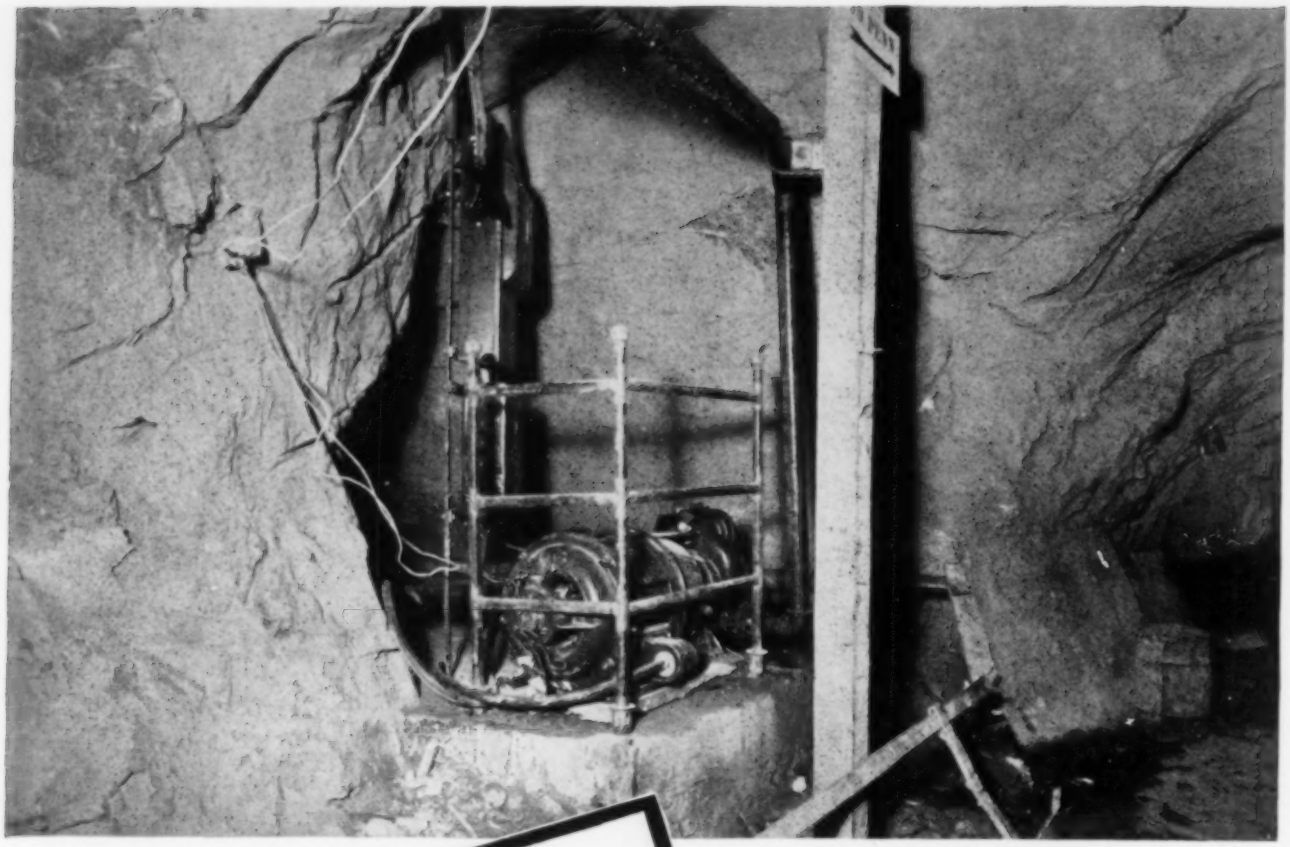
Oil bath breather filter for tanks, presses, etc.

Oil-wetted type breather filter.

These are but a few of the hundreds of specialized filters developed by Air-Maze. Send for catalog AGC 144.

AIR-MAZE CORPORATION • *Engineers and Manufacturers* • **CLEVELAND 5, OHIO**

Representatives in Principal Cities • *In Canada:* Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver, B. C.



● *Built by* INGERSOLL-RAND CO.

Dependable the year around

SKF

BALL AND ROLLER BEARINGS

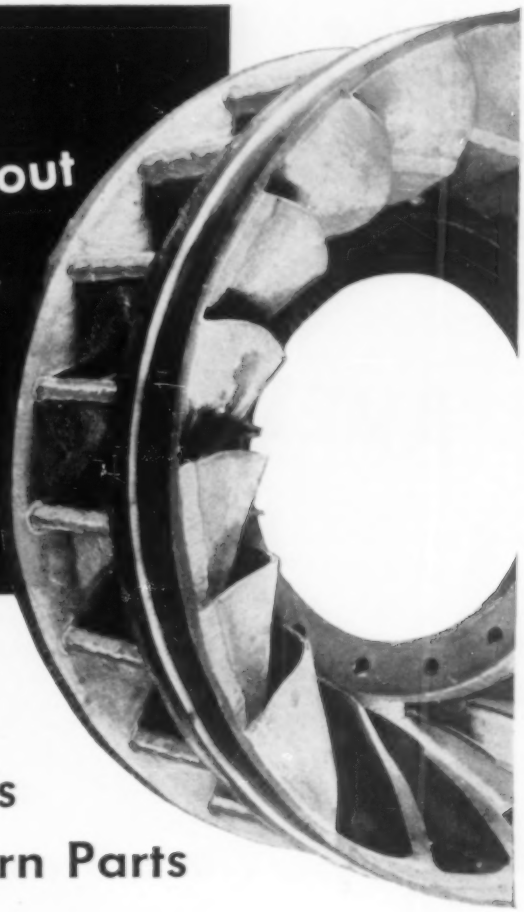
The only moving part in a centrifugal pump is the rotor consisting of all parts mounted on the shaft. The bearings which support the rotor, therefore, are highly important. They are *vital* to dependable pump performance when the pump is located in a mine where help required for frequent attention is often at a premium.

For that reason the bearings on this Motorpump are SKF's—a Duplex Angular Contact Ball Bearing on the pump end and an SKF Deep Groove Ball Bearing on the motor end.

Hour after hour, week after week, year after year, these long lived, low lubricant-consuming bearings keep the rotor properly aligned and running smoothly . . . helping this pump to help the mine to produce more raw materials for Victory. 5662

SKF INDUSTRIES, INC. • FRONT ST. & ERIE AVE. • PHILADELPHIA 34, PA.

Use it up • Wear it out
Make it do • Or do without
Uncle Sam



No need to "do without"—
Bronze Welding is Industry's No. 1 Tool for Salvaging Worn Parts

For building-up worn surfaces or making repairs to cast iron, malleable iron, steel or copper alloy parts, there's nothing so economical and dependable as Bronze Welding. That large bearing, for instance: It was worn out giving years of service on a nail making machine. Replacement from stock was impossible, yet the manufacturer just couldn't "do without." Built up with strong, tough, dense-grained Anaconda Manganese Bronze Welding Rod and machined, the bearing was quickly returned to service.

Or that 5,000 hp. turbine runner: Stones and gravel brought in with ice in the Spring badly damaged some of the buckets while others were broken off completely. Again Bronze Welding was used to build up the worn surfaces and weld in new patches. The cost, compared with that of a new runner, was negligible.

Maintenance men everywhere are taking advantage of the salvage and repair opportunities made possible with the oxy-acetylene torch and such rods as "997" Low Fuming, Tobin Bronze* and other Anaconda Welding Rods. Applications of these rods are described in Anaconda Publication B-13. Write for a copy.

*Reg. U. S. Pat. Off.

Here's a Suggestion List

Parts and place where Bronze Surfacing will "make it do"

Sheaves
Pulleys
Clutches
Thrust Plates
Bushings
Bearings
Hubs
Flanges
Pistons
Impellers
Pump Parts
Pipe Threads
Stripped Holes
Gear Teeth
Reciprocating Parts
"*Safe-ending*" Hammer Struck Tools

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut • *Subsidiary of* Anaconda Copper Mining Company

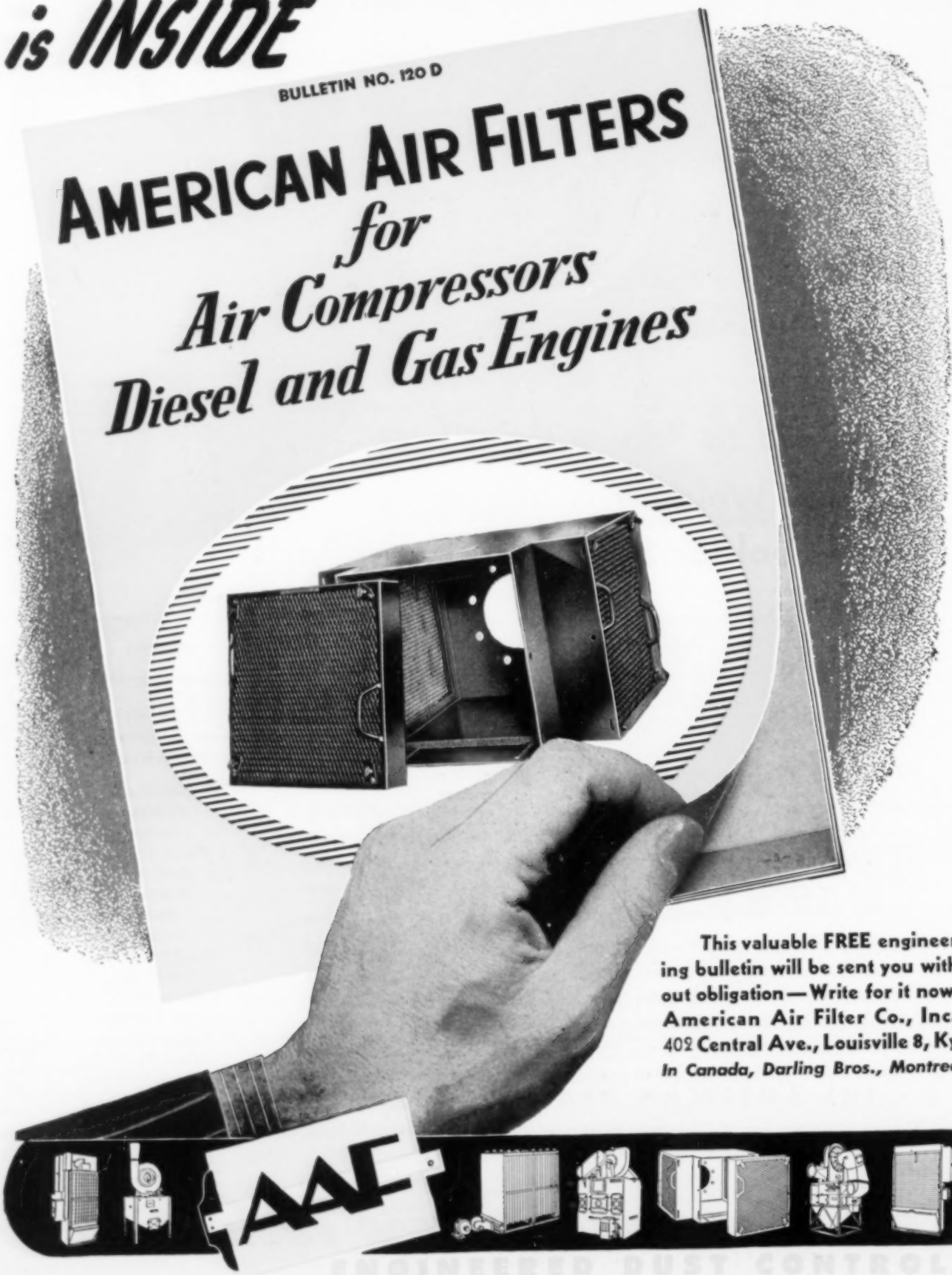
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

4491

ANACONDA
from mine to consumer

Anaconda Bronze Welding Rods

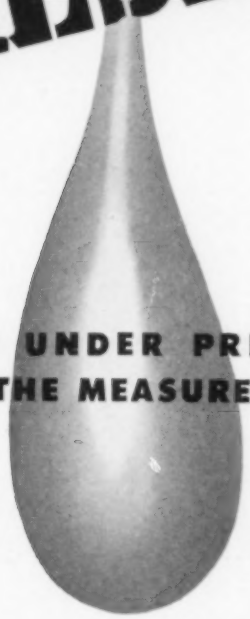
The Answer to Your Air Filter Problem is INSIDE



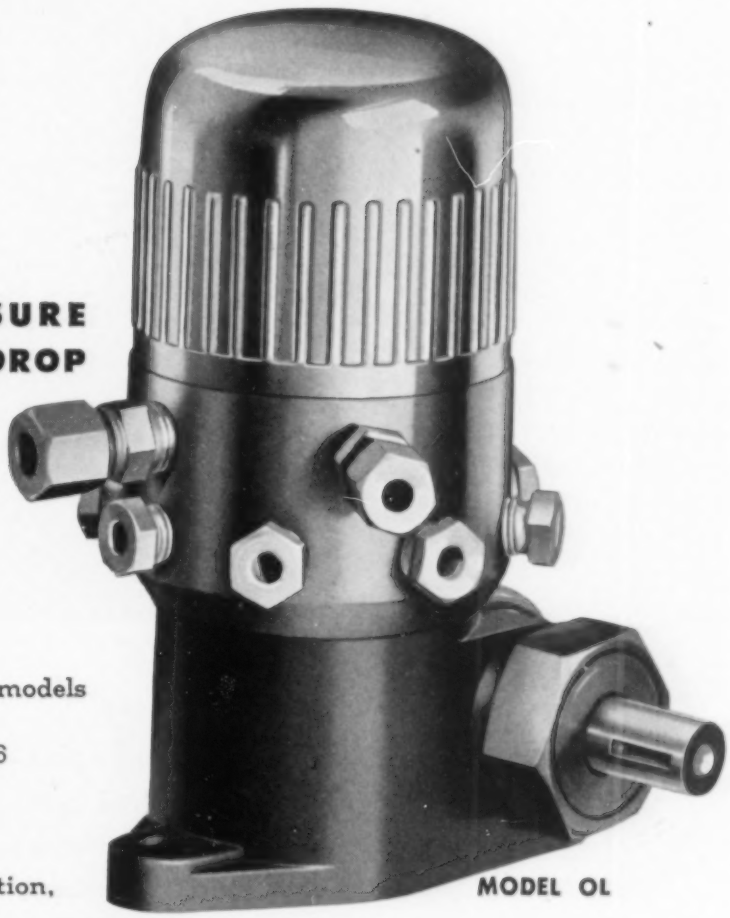
This valuable FREE engineering bulletin will be sent you without obligation—Write for it now!
American Air Filter Co., Inc.,
402 Central Ave., Louisville 8, Ky.
In Canada, Darling Bros., Montreal

ENGINEERED DUST CONTROL

MADISON-KIPP FRESH OIL



FED UNDER PRESSURE BY THE MEASURED DROP



MODEL OL

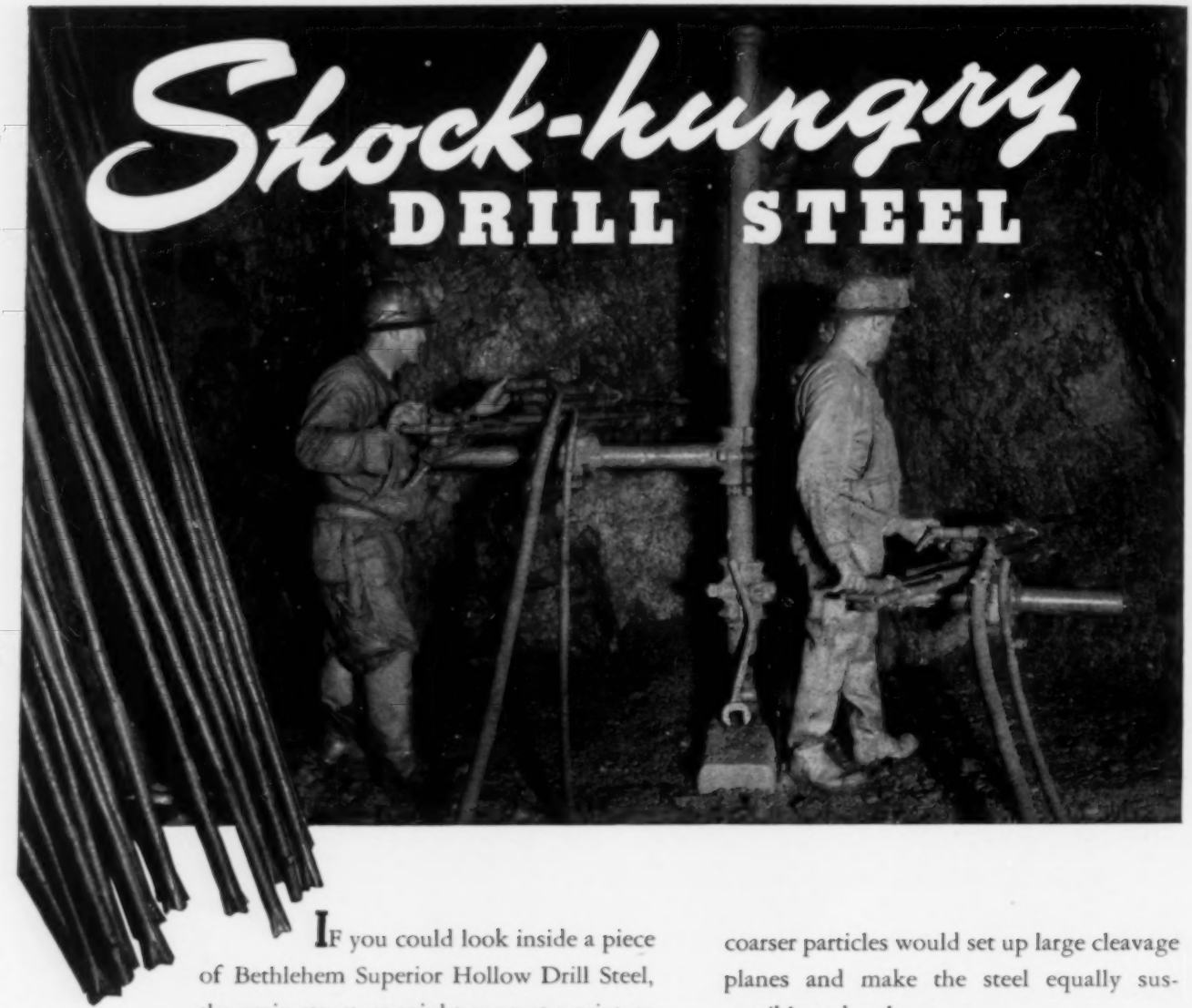
There are Madison-Kipp lubricator models for every Fresh Oil application. There are 6 models and each can be varied to suit the requirements in drive type and location, in number of feed outlets, rate of feed and pumping pressure. Madison-Kipp specializes in original standard equipment lubricators. When you buy new machinery it will pay you to specify Madison-Kipp . . . the most dependable method of lubrication ever developed.

MADISON-KIPP CORPORATION, 202 Waubesa St., Madison 4, Wis.

Sole Agents in England: Wm. Coulthard & Co., Ltd., Carlisle

THE MOST DEPENDABLE METHOD OF LUBRICATION EVER DEVELOPED

Shock-hungry DRILL STEEL



IF you could look inside a piece of Bethlehem Superior Hollow Drill Steel, the grain structure might suggest a mixture of walnuts and oranges, on a greatly reduced scale. For in Bethlehem Superior the grain size is mixed—"balanced"—and the result is longer life, greater resistance to breakage, lower percentage of failures.

If all the particles were of the more minute type, thousands of tiny cleavage planes would be created; under repeated impact, a series of cracks and ruptures would soon appear. On the other hand, a grain structure consisting entirely of the coarser particles would set up large cleavage planes and make the steel equally susceptible to breakage.

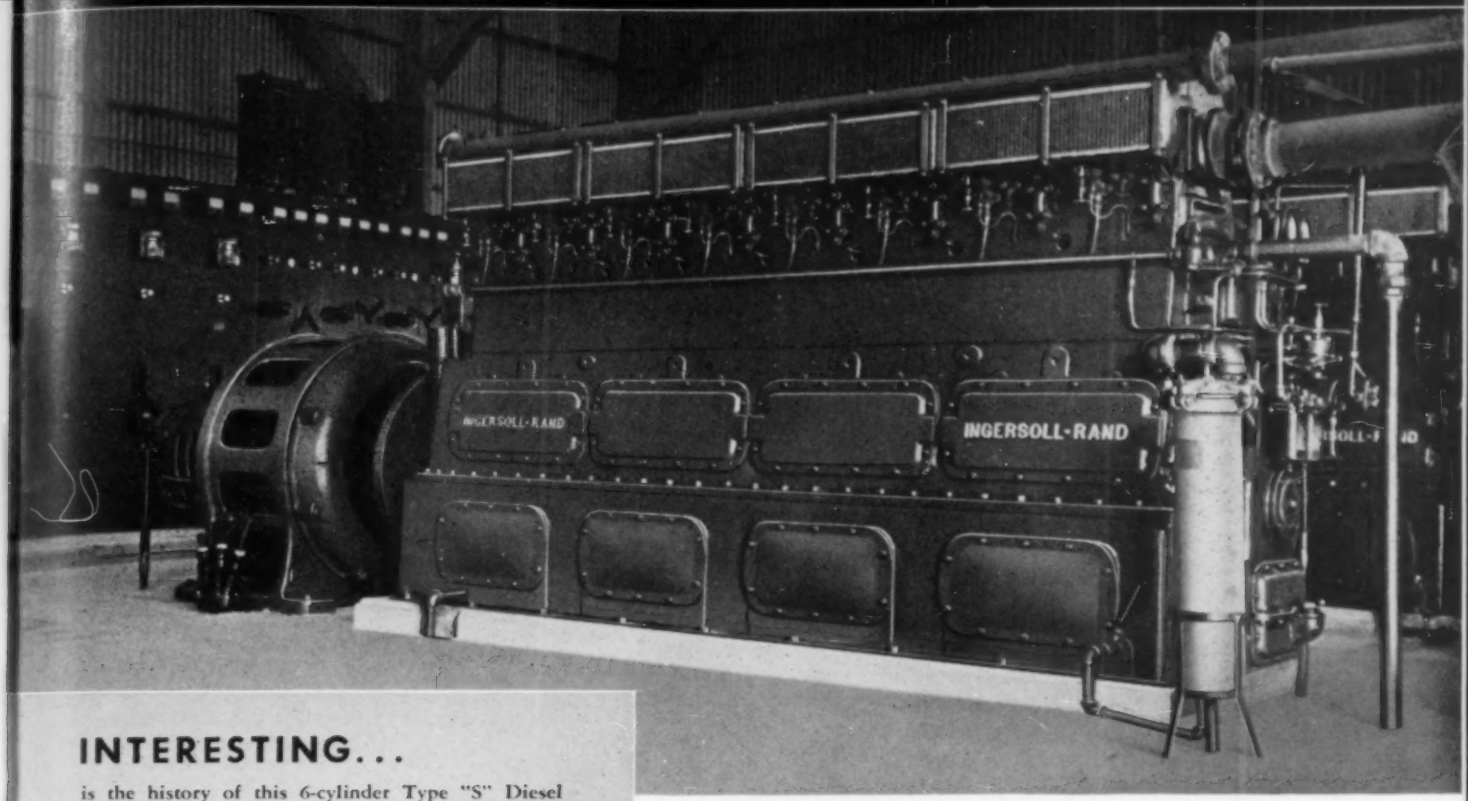
Bethlehem Superior has neither of these undesirable extremes. There are no long, direct lines of cleavage; nothing in the structure to encourage premature failure.

What it *does* have is an unusual appetite for shocks—it's shock-resisting to a high degree. Next time you order drill steel, make it Bethlehem Superior. You'll see for yourself.

Bethlehem Superior Hollow Drill Steel

BETHLEHEM STEEL ★

HEAVY-DUTY Diesel Engine

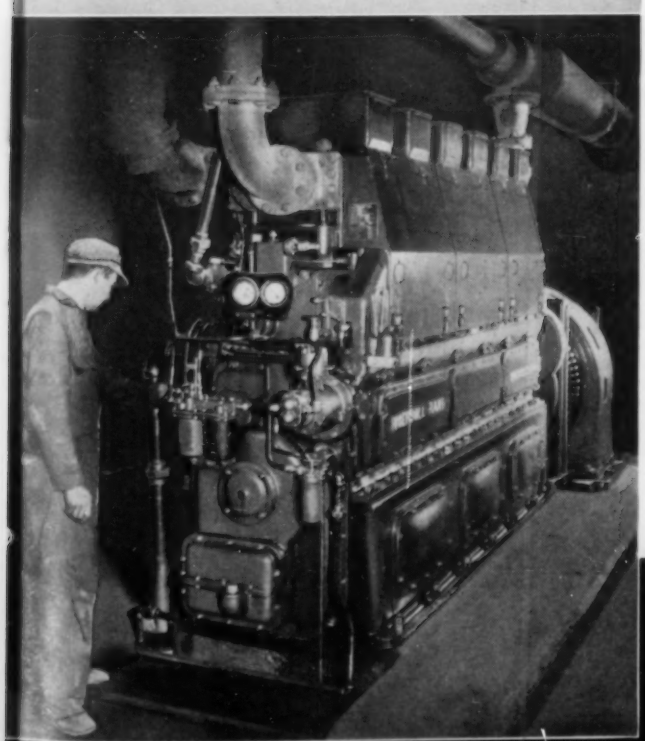


INTERESTING...

is the history of this 6-cylinder Type "S" Diesel Engine. In 1937 it was installed 9,000 feet above sea level in a Western metal mine. Since that time it has run almost continuously, 24 hours each day... generating all the electric power needed for the flotation mill.

Each September this engine is shut down for inspection and overhaul. It has never been stopped because of any mechanical failure.

The Type "S" is truly a **HEAVY-DUTY ENGINE.**



Two 8-cylinder Type "S" engines which supply power for the construction of a large dam in Mexico. A total of 12 I-R engines are used in this irrigation program.

The Ingersoll-Rand Type "S" is a continuous-service engine of compact design. It is of the 4-cycle, solid-injection type having complete force-feed lubrication and many other refinements normally found only in much larger engines.

The exceptionally low fuel consumption of less than 0.40 pounds per bhp-hr results in low overall power costs. In every respect, the Type "S" is the outstanding Diesel engine.

Engines of 3, 4, 5, 6, 7, and 8-cylinder sizes ranging from 225 to 600 hp are available. All sizes operate at 720 rpm.

Let your local Ingersoll-Rand engineer give you more details about the Type "S". Perhaps he can help you to solve a power problem.

7-409

Ingersoll-Rand

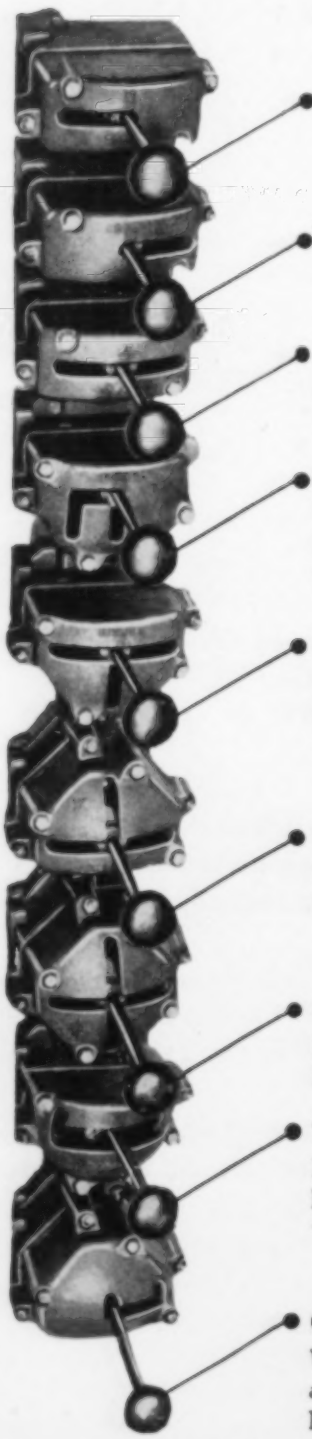
11 BROADWAY, NEW YORK 4, N. Y.

FLEXAIR VALVES

For remote pneumatic control of cylinders, clutches, hydraulic couplings and other power mechanisms. Ideal for centralized, graduated control of operations on cranes, whirleys, shovels, oil drill rigs, hoists, dredges and production machines.

Stock valves available as shown. Other combinations to suit the installation.

Ask for
Catalog IDC 9306-1



- Single Operation—Pull Type.
- Single Operation—Push Type.
- Two Operations—Push and Pull from Central.
- For Operating Two Power Devices—Either Singly or Combined.
- Three Operations—Push, Pull and Right Sideway.
- Three Operations—Push, Pull and Left Sideway.
- Four Operations—Push, Pull, Right and Left.
- Two Operations—Double Control of a Power Device with "Trip" at any Point.
- One Operation—With "Trip" at Release and Fully Applied Positions.

WESTINGHOUSE AIR BRAKE CO.

Industrial Division WILMERDING, PA.

Illustration:

This tank track part is fabricated by brazing together precision machined alloy tubing and forgings.

Hydrogen Copper Brazed, cooled, re-heated and quenched by Burgess-Norton in one continuous furnace operation.

of the completeness of Burgess-Norton's facilities for post-war production of precision parts which will be available to manufacturers when Victory Day draws nearer.

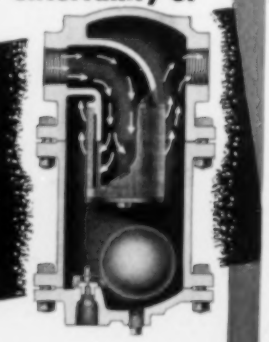
Burgess Norton MANUFACTURING COMPANY
40 years in GENEVA, ILLINOIS

Precision Finishing as performed by Burgess-Norton is exemplified by the production of piston pins with finishes as fine as 2 micro inches.

A Part is Never Made Right unless it is Satisfactory to Our Customers

✓Eliminates need for external traps
✓Ends the bother and uncertainty of manual draining

The NEW Johnson SELF DRAINING Compressed Air Separator



•Here is the time-proved Johnson Separator with a complete trap mechanism built right in—today's newest idea in Separator design. It combines the two best principles of separation—first allows the air to expand slightly, then changes direction of flow abruptly many times with the "thousand baffles"—removes more than 99% of water, dirt and oil. The simple trap mechanism, mounted on bottom plate for easy access, releases the accumulated moisture from the Separator automatically, whenever necessary.

Johnson Separation Devices include Separators for Compressed air or Steam, After Coolers, Oil Absorbers.

WRITE FOR CATALOG

The Johnson Corporation

830 WOOD STREET THREE RIVERS, MICHIGAN

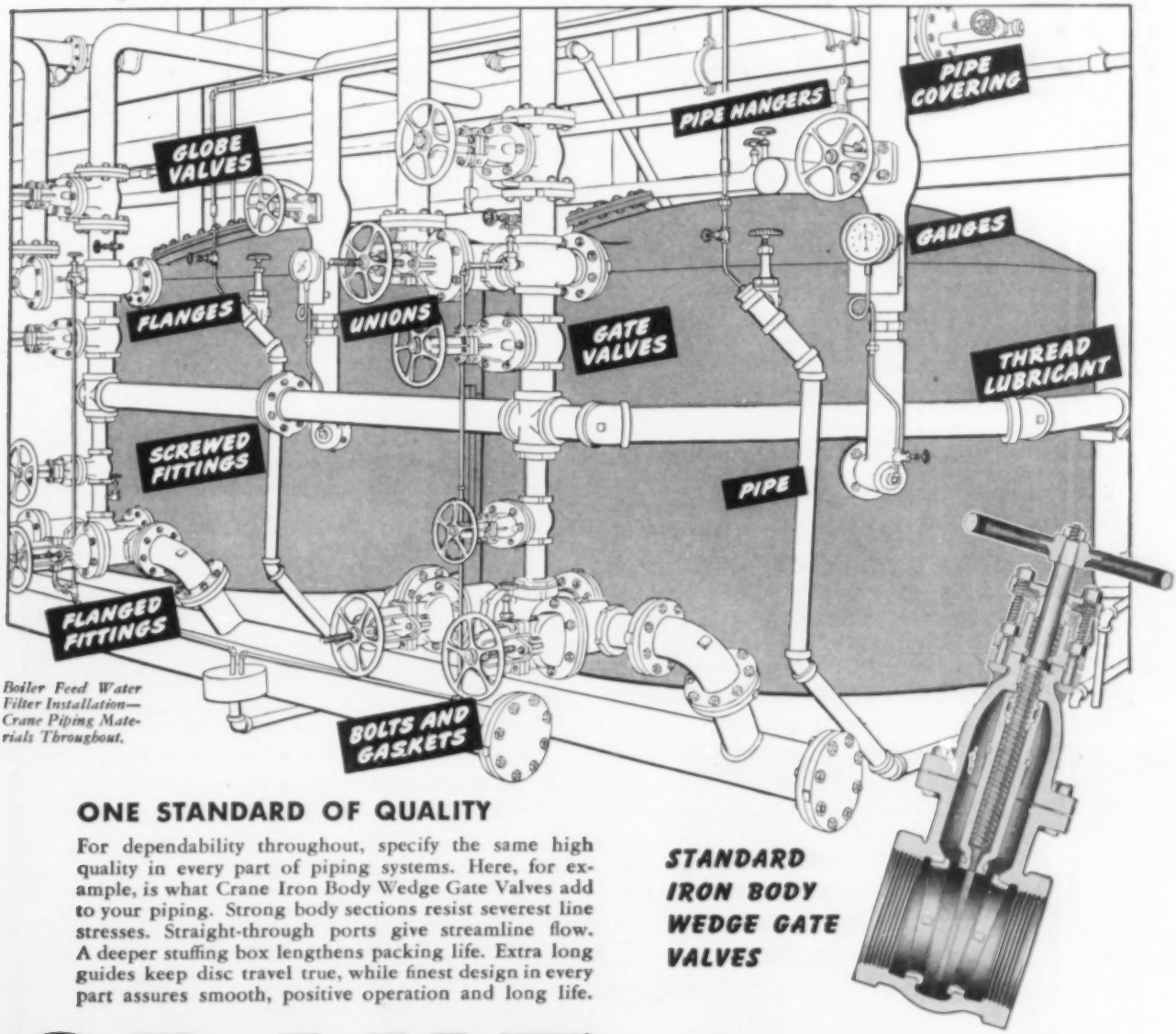
You name the Piping Service CRANE supplies the Equipment

ONE SOURCE OF SUPPLY . . . ONE RESPONSIBILITY FOR ALL MATERIALS

Valves—fittings—pipe—fabricated assemblies—and piping accessories—for power or processing lines—high, moderate, or low pressure—all your needs for any installation are available from a single source: Crane. Just name the fluid to be handled—your Crane Branch offers the world's greatest selection of quality materials—in brass, iron and steel—for every piping service.

Better installations start with parts whose quality and craftsmanship are backed by a single responsibility. Ordering, maintenance work, storing of parts and getting emergency replacements—all such steps are simplified by Crane *complete* materials service. Your satisfaction with Crane products is assured by Crane Co.'s 89-year experience and leadership in the piping equipment field.

CRANE CO., General Offices: 836 South Michigan Avenue, Chicago 5, Illinois. *Branches and Wholesalers Serving All Industrial Areas.*



Boiler Feed Water Filter Installation—Crane Piping Materials Throughout.

ONE STANDARD OF QUALITY

For dependability throughout, specify the same high quality in every part of piping systems. Here, for example, is what Crane Iron Body Wedge Gate Valves add to your piping. Strong body sections resist severest line stresses. Straight-through ports give streamline flow. A deeper stuffing box lengthens packing life. Extra long guides keep disc travel true, while finest design in every part assures smooth, positive operation and long life.

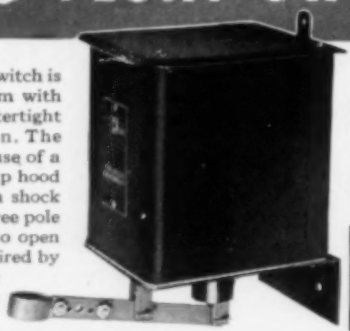
STANDARD IRON BODY WEDGE GATE VALVES

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Marine FLOAT SWITCH

DRIPPROOF AND WATERTIGHT
HIGH SHOCK CONTACT BLOCK
TWO OR THREE POLE
CLASS 9036 • TYPE AW-H



● The class 9036 type AW-H float switch is built for Marine Service to conform with requirements for a dripproof and watertight device of shockproof construction. The switch differs from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block of two or three pole form. The switch can be arranged to open or close on rise in liquid level as required by application. Mounting is three point by means of bracket flange and foot, as illustrated. **Write for Bulletin 563.**

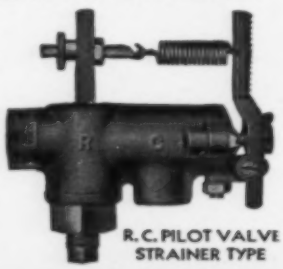
ELECTRICAL RATINGS

Voltage	Single Phase A. C.	Polyphase A. C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.

REGULATOR DIVISION
SQUARE D COMPANY
DETROIT • MICHIGAN

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE
STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET • ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

BALANCED RODS

Another
PLUS FEATURE
IN ALL
WISCONSIN
Air-Cooled
ENGINES

Every connecting rod, in every Wisconsin Air-Cooled Engine, is precision-balanced to eliminate all weight variations in excess of ¼-ounce per rod.

This is admittedly cutting it pretty fine for a rough-and-ready heavy-duty engine . . . but not *too* fine for these fine engines. Smooth operation, reduction of vibration to a negligible minimum, prevention of excessive wear . . . these are factors that can be controlled only by the most meticulous care and attention to such small details as this in building an engine.

The *value* of this attention comes into play when a Wisconsin Air-Cooled Engine powers your equipment.

Most H.P. per pound
WISCONSIN MOTOR
Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

NON-SEIZING AND NON-SCORING* RESISTANT TO HEAT, SHOCK, GRIT.
➧ ***SELF-LUBRICATING***

**U. S. Govt. report states " . . . will not . . . melt like babbitt, or freeze on the shaft like bronze".*

BEARIUM METAL

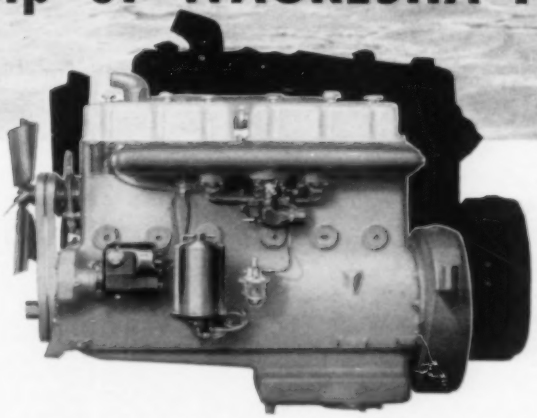
COMBINES BEST BEARING FEATURES OF BOTH BABBITT AND BRONZE

By an exclusive process, *minute lubricating lead globules are evenly distributed throughout the bronze matrix.* The resulting unusual frictional properties of *Bearium Metal* have steadily increased its use for tough bearing problems everywhere . . . from motion picture projectors to power shovels . . . from high-speed machine tools to blooming mills . . . from compressors and Diesels to rock crushers.

BEARIUM METALS CORP.
270 State Street, Rochester 4, N. Y.
Write for Full Information on this Amazing Bearing Alloy

The U.S.S. OKLAHOMA "COMES BACK" with the help of WAUKESHA POWER....

Press Association, Inc.



■ Powered by Waukesha Engines, two of a battery of big Ingersoll-Rand K-500 portable air compressors . . . mounted on the barge at the right . . . are shown helping to raise the *U.S.S. Oklahoma* after the Japanese raid on Pearl Harbor.

A battleship of some 29,000 tons, the *Oklahoma* had completely capsized before sinking. Lying in shallow water—bottom up—she had to be righted as well as floated.

To raise her, compressed air in large volumes was used—to force water in flooded compartments down and out through valves fitted to bottom plating—or, to lower water by expelling it through holes in the hull, closing holes with emergency patches and then unwatering the compartments.

Here was another place where Waukesha wartime engines could *and did* help the Navy to speed up its tremendous task of salvaging.

Seventeen months after Pearl Harbor 16 of the 19 ships that had been sunk and damaged were salvaged and back in active service with our Navy.

When time counts . . . and it did here more than it ever had before . . . you can push Waukesha-powered equipment far, fast and furious—all around the clock *again and again* until the job is done. That's dependability! Waukesha wartime engines have it. The new Waukesha peacetime engines will have it, too. Consult Waukesha about your future engine needs.

WAUKESHA ENGINES

MORE POWER FOR VICTORY

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

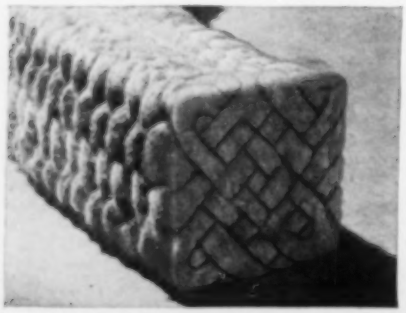
"GARLOCK Packings and Gaskets are doing a job on our ships—they'll help us lick our packing problems at the plant back home, too!"

"And don't forget how well those KLOZURE Oil Seals are working out."

Yes, GARLOCK products give superior performance for our Armed Forces and for industry everywhere. You can rely on their dependable service.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.



GARLOCK LATTICE-BRAID PACKING. The unique structural design imparts semi-automatic pressure action. Available in several styles for various types of service.

GARLOCK

POWER
SMOOTH AS SILK

By installing NORGREN (air-line) LUBRICATION ... you get smooth, maximum air power, plus positive protection against wear and destructive corrosion.

OIL THE AIR... CHECK THE WEAR

Norgren air line lubricators maintain film of oil on every moving part of air tool. Check wear. Stop destructive corrosion.

Automatic — work only when tool works. Sight feed—ends guesswork. Simply installed—direct to air line. Write for complete information: C. A. Norgren Co., 220 Santa Fe Drive, Denver, Colorado.

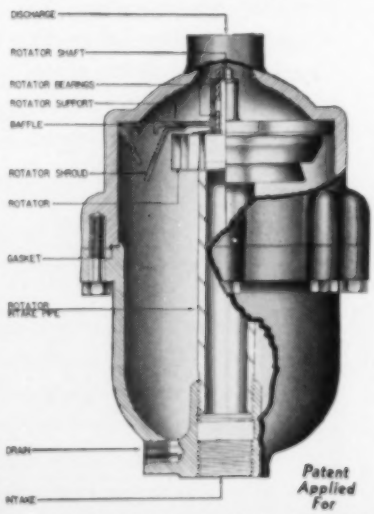
Norgren

Catalog 400

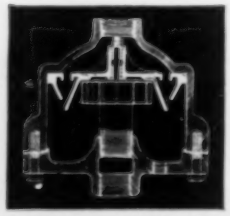
NEW TURBO-ROTOR *Pur-O-fier*

For Compressed Air

This new unit effectively eliminates moisture, oil and scale from compressed air lines. Pur-O-fier utilizes the principle of centrifugal force to separate entrainments from purified air. Once installed it requires absolutely no maintenance. Penstar Tru-Bond oiless bearing guarantees long, trouble-free operation. Manual or automatic drains provided.



Patent Applied For



Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

THREE MODELS AVAILABLE—A-1 will accommodate volumes from ½ to 5 cu. ft. A-2, volumes from 10 to 35 cu. ft. A-4, volumes from 35 to 100 cu. ft. Multiple units are recommended for volumes above this range. Pur-O-fier is the only standard unit that can be engineered to meet any air volume for regular or intermittent service.

BIRD-WHITE COMPANY
3120 West Lake Street, Chicago, Illinois

Wherever wire rope is fastened
STANDARDIZE
on Genuine
CROSBY CLIPS
with the Red U-Bolt

A safe, lasting and easy-to-put-on clip for every size of rope from 1/8-inch to 4-inch.

Sold by leading distributors everywhere

AMERICAN HOIST & DERRICK CO.
SAINT PAUL 1, MINNESOTA
CHICAGO SAN FRANCISCO NEW YORK

THE GENUINE *Crosby Clip* WHEREVER WIRE ROPE IS FASTENED

There Is No Compressed Air Condition So Bad In Any Factory That We Cannot Correct and Completely Remedy

WATER removed from AIRLINES AUTOMATICALLY with the MURPHY SEPARATOR

SIZES ½" TO 4" PIPE
Literature and Prices on request

RESULTS - - - GUARANTEED
NO ABSORBENTS - NO CHEMICALS
AFTERCOOLERS - - - SPRAYERS

JAS. A. MURPHY & CO.
HAMILTON, OHIO

It's to YOUR Advantage to use

Wagner Air-Cooled TRANSFORMERS

Because they are–

Safe for either indoor or outdoor installation.

Compact and easy to install.

Usable right at load.

STUDY THESE FEATURES:

1. Dry-type... no liquid.

2. Core and coils are vacuum treated in compound for protection against moisture.

3. Totally enclosed.

4. Provided with built-in junction box with knockouts on sides and bottom for conduit or open wiring.

5. Large removable coverplate of junction box assures ease in making connections.

6. Hanger-lugs designed for ease in mounting.

7. All ratings within the limits of the National Board of Fire Underwriters have the Underwriters' approval.

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING
T44-10A

Write FOR COMPLETE LITERATURE

ARMY-NAVY E

NATIONAL SECURITY AWARD

Wagner Electric Corporation
ESTABLISHED 1891
6418 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

WITH BUCYRUS-MONIGHANS IT'S *All Weather* PERFORMANCE

When bad weather makes footing too soft for other excavators, your Bucyrus-Monighan walking dragline will keep going, delivering the big output for which it is famous. Smooth walking traction carries it safely, surely around trouble — the large bearing area provides solid footing even in soft muck. Long reach, quick swing, fast hoisting, and controlled lowering insure fast digging.

That's the essence of the Bucyrus-Monighan performance story—the result of "years-ahead" design and construction, the reason you get your excavating work done **fast** with a Bucyrus-Monighan on the job.

Plan now to include field-proved Bucyrus-Monighans in your excavating equipment. Take advantage of their all-weather performance for quick solutions to your digging problems.

B-31

Sold by

BUCYRUS-ERIE COMPANY

"Years Ahead" Excavators for the Years Ahead

SOUTH MILWAUKEE, WISCONSIN

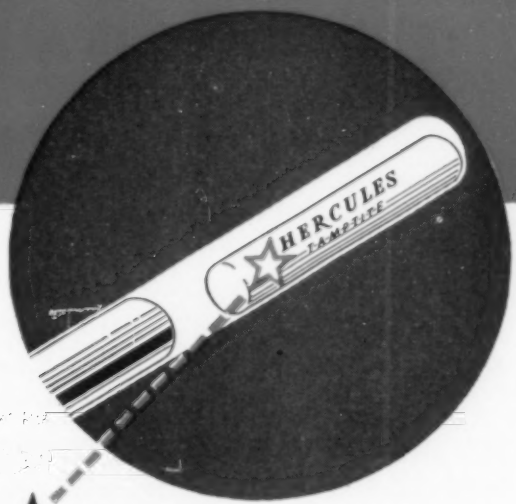
TAMPTITE

SAVES TIME

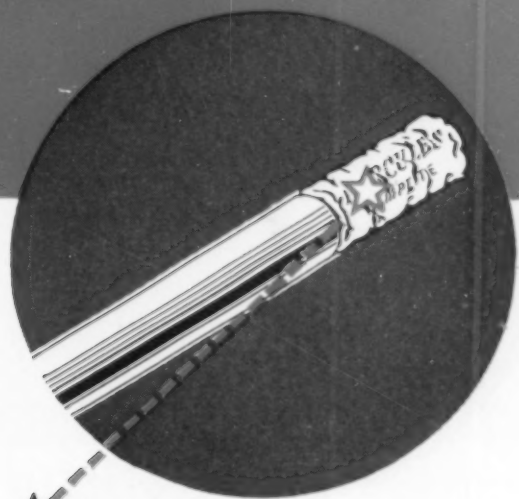
SAVES LABOR

PACKS SNUGLY

GIVES BETTER BREAKAGE

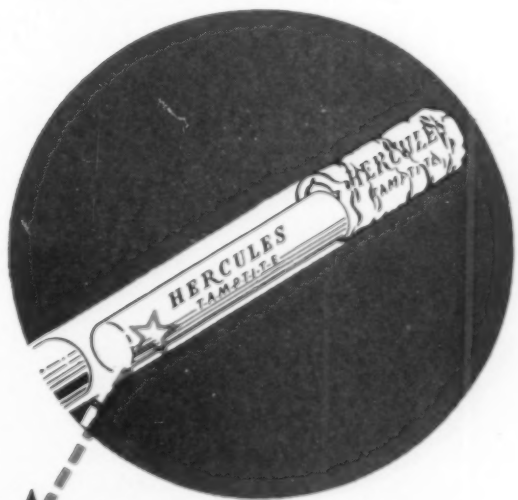


1 **FASTER LOADING** of bore holes is possible with Tamptite because there is no wasted time splitting cartridges, no fuss or bother. You simply insert a Tamptite cartridge and tamp.



2 **TIGHTER CHARGING** is bound to result because both dynamite and the Tamptite wrapper expand to fill the bore hole tightly, snugly. Virtually no air space remains around the charge.

Order your favorite Hercules explosives in Tamptite cartridges. All the customary grades and sizes of Hercules Gelamites*, Hercomites*, Extra Gelatins, Gelatins, and Extra Dynamites are available in this time-saving wrapper.



3 **BETTER BREAKAGE** of the ore or rock occurs because the entire charge is concentrated exactly where you want it. The result is speedier mucking and a faster mining cycle.

HERCULES

EXPLOSIVES

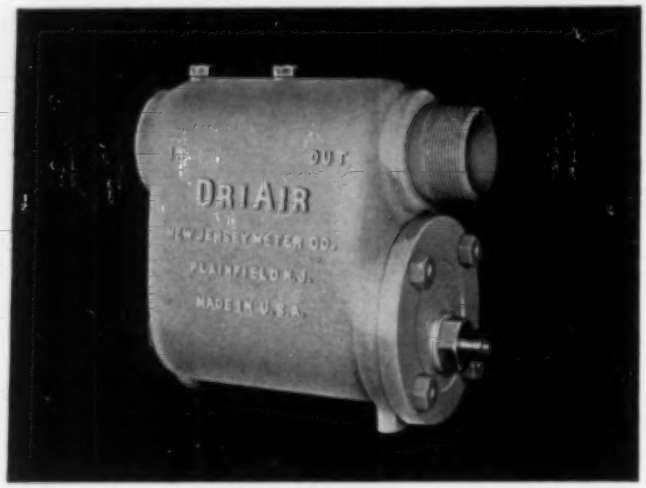
HERCULES POWDER COMPANY INCORPORATED ..... 932 KING STREET · WILMINGTON 99, DELAWARE

*REG. U. S. PAT. OFF.

XR-42

ORDER HERCULES EXPLOSIVES IN TAMPTITE CARTRIDGES

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

"Aero-Seal" HOSE CLAMPS

Distinctive worm gear tightening action provides powerful belt-like pull-up. Uniform pressure all around prevents leaks. Can be put on or taken off hose in place on pipe. Can be re-used. No loose parts. Compact design. Extremely long take-up. Made in sizes from ½" up. *Write for circular.*

Proved outstandingly reliable in severe service on aircraft fuel, oil, and coolant lines.

AIRCRAFT Standard PARTS CO.

Aircraft Standard Parts Co.

1771K NINETEENTH AVE., ROCKFORD, ILL.

BURGESS SNUBBERS

for

Quiet Compressor Intakes

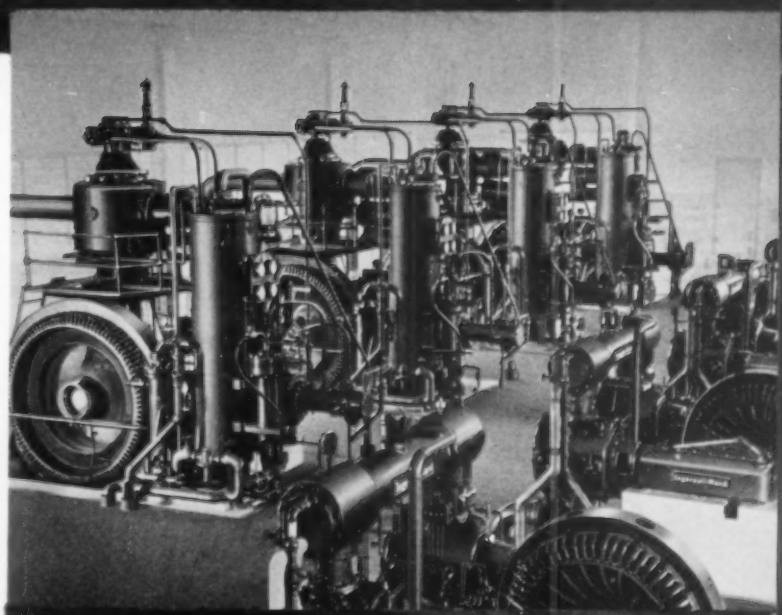
BURGESS-MANNING COMPANY
Chicago, Illinois

AIR POWER for SEA POWER

Inside a modern torpedo, compressed air supplies the oxygen needed to burn alcohol in a tiny boiler which generates the steam for running the torpedo's turbine and propellers. It also operates the gyroscope, and controls the torpedo.

In order to store a lot of air within a small space, this air is compressed to about 3000 pounds per sq inch pressure. For charging torpedoes on board Navy fighting ships and at Army and Navy airfields, Ingersoll-Rand has built hundreds of high-pressure heavy-duty compressors of small, compact design. Some of these are small enough to fit into the baggage compartment of your car.

Compressed-air power is also essential to the manufacture and testing of torpedoes. Shown here is a battery of Ingersoll-Rand air compressors consisting of four 400-horsepower, 4-stage units supplying 4000-pound air for testing, and four 2-stage machines furnishing 100-pound air power needed in the manufacturing process. Identical installations of these compressors are in two other torpedo plants.



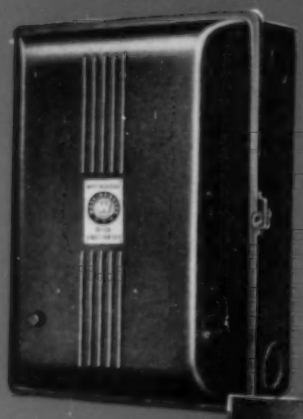
Ingersoll-Rand has built air and gas compressors for pressures from vacuum to 15,000-pound per sq inch for all kinds of services. Call upon this experience when you need compressors.

1-458

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES



Across-the-line A-C Magnetic Starter for Squirrel-cage Motors.

Reversing and Non-reversing Magnetic Starter.

Autotransformer Type Magnetic Reduced Voltage Starter.

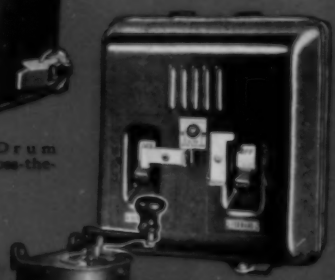
Starting and speed regulating Rheostat.

Manual Motor-starting Snap Switch.

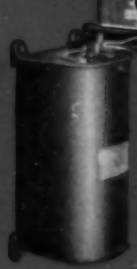
Reversing Drum Switches for Across-the-line Starting.

Type H Sentinel Breaker for Fractional Hp Motor Starting.

Manual Multi-speed Drum Controllers.



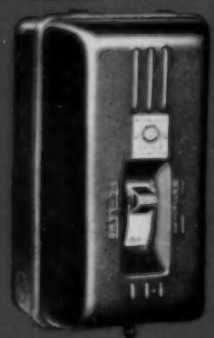
"De-ion" Motor Watchman Reversing and Two-speed Manual Starters.



Manual Multi-speed Drum Controllers.

Reversing Drum Controller for use with Primary Resistance.

Across-the-line "De-ion" Manual Motor Starter.



Standard Motor Control

FOR POSTWAR RECONVERSION

Westinghouse All-Purpose A-C Controls

Postwar reconversion will bring important control problems—you'll need all-purpose controls—and you'll need them quick.

Westinghouse is ready NOW to help you solve these problems—with a complete family of A-C Controls, a few of which are pictured here. They offer the maximum in flexibility of application and ease of installation.

Start now to anticipate your postwar control needs. For your assistance, Westinghouse has compiled a complete new volume of Control Buying Data (Catalog 7000). Get your copy today from the nearest Westinghouse district office (distribution will be made from district offices only—no mailings from Westinghouse headquarters). Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penna.

J-21307

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

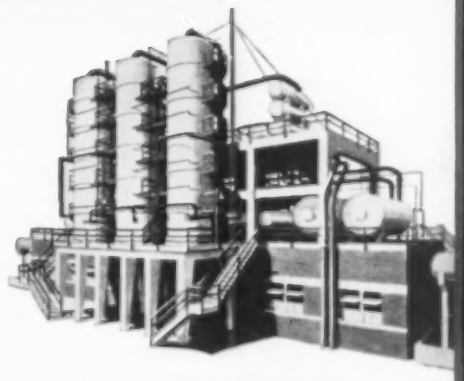
Motor Control

FOR THE FIGHTER... AND HIS DREAM!

The fighter must have something to fight for as well as something to fight with. It is industry's task to back him with weapons today and tools tomorrow.

Blaw-Knox makes its own long list of war weapons, as well as basic equipment to aid other manufacturers in their war efforts. When the international reconstruction program begins, Blaw-Knox will supply a wide range of equipment to speed it. Blaw-Knox leads in many fields. For example: rolls, mills and other essentials for the ferrous and non-ferrous industries . . . highly specialized fabricated products for railroads, public utilities, the electronic and construction industry and industry in general. For the chemical and process industries Blaw-Knox produces all types of equipment, even complete plant units.

Whatever your plans perhaps Blaw-Knox products and services can be useful to you. Let us discuss it at your convenience.



A typical example of Blaw-Knox design and construction for the Chemical and Process Industry.

BLAW-KNOX COMPANY

2654 Farmers Bank Bldg., Pittsburgh, Pa.

A Pacemaker for American Initiative and Ingenuity

Buy More War Bonds and Stamps

LEWIS FOUNDRY & MACHINE DIVISION, Rolls and Rolling Mill Machinery

NATIONAL ALLOY STEEL DIVISION, Heat and Corrosion-Resistant Alloy Castings

SPECIAL ORDNANCE DIVISION, Bofors Anti-Aircraft Gun Mounts and Mechanisms

PITTSBURGH ROLLS DIVISION, Rolls for Steel and Non-Ferrous Rolling Mills

POWER PIPING DIVISION, Prefabricated Piping Systems

BLAW-KNOX DIVISION, Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

COLUMBUS DIVISION, Ordnance Matériel

UNION STEEL CASTINGS DIVISION, Steel and Alloy Castings

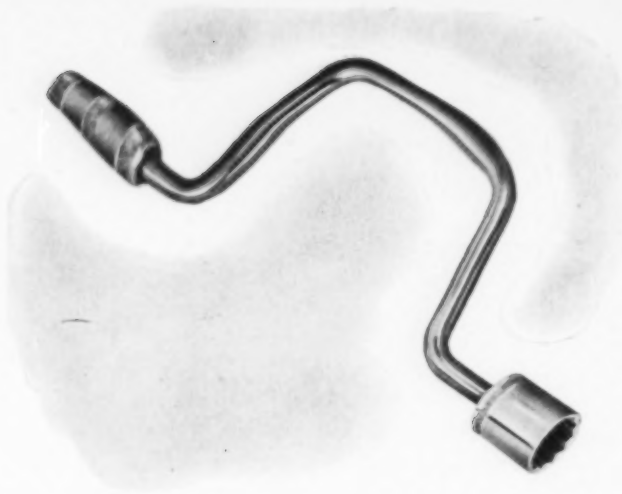
MARTINS FERRY DIVISION, Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION, Automatic Sprinklers and Deluge Systems

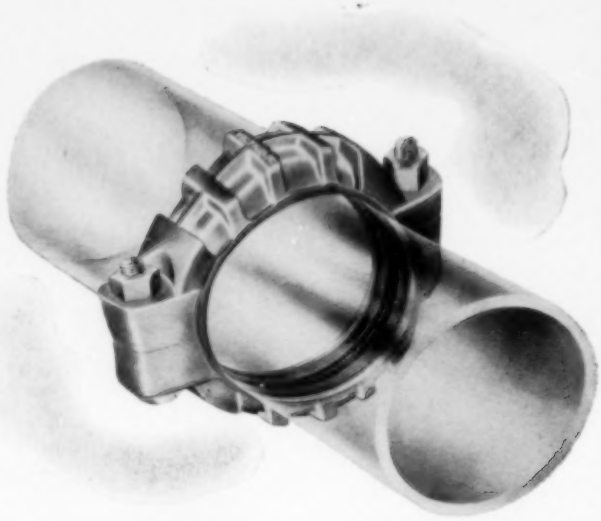
Five Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · GUN SLIDES · LANDING BARGES · AERIAL BOMBS · POWDER PLANTS · PIPING FOR NAVAL VESSELS · SYNTHETIC RUBBER PLANTS · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS



With nothing but a simple wrench



...plus Victaulic Couplings...

Even inexperienced men can connect as much as

30 MILES OF PIPE A DAY!

WAR BONDS

Where time is worth money in industry...the speed and ease with which you can couple pipe by Victaulic really count in man-hours saved. There's no guesswork, no marking of pipe...Victaulic Couplings center automatically on pipe. Need for accurate alignment of pipe lengths is eliminated ...pipe lines can follow contours, curves, with a minimum of bends and fittings.

For full details on this leak-tight, mechanically locked flexible pipe coupling ...write for our new Victaulic Catalog and Engineering Manual . . . Address VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. Other Victaulic offices—Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Co. of Canada, Ltd., 200 Bay St., Toronto.

THERE'S ONLY ONE

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

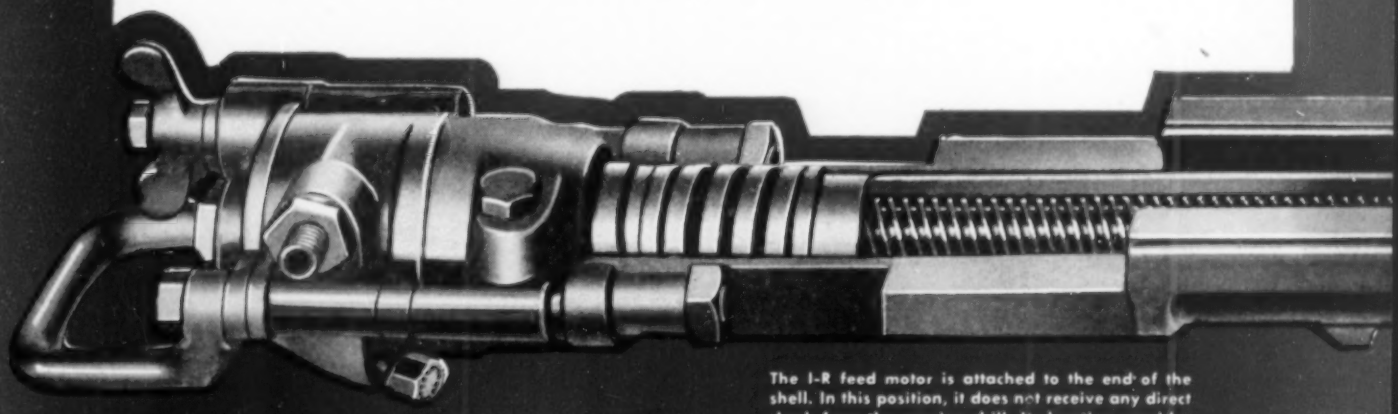
Copyright 1944 by Victaulic Co. of America

OIL MINING MARINE MUNICIPAL INDUSTRIAL

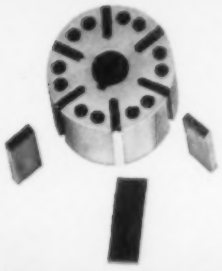
INCREASE DRILLING SPEED . . .

WITH POWER-FEED

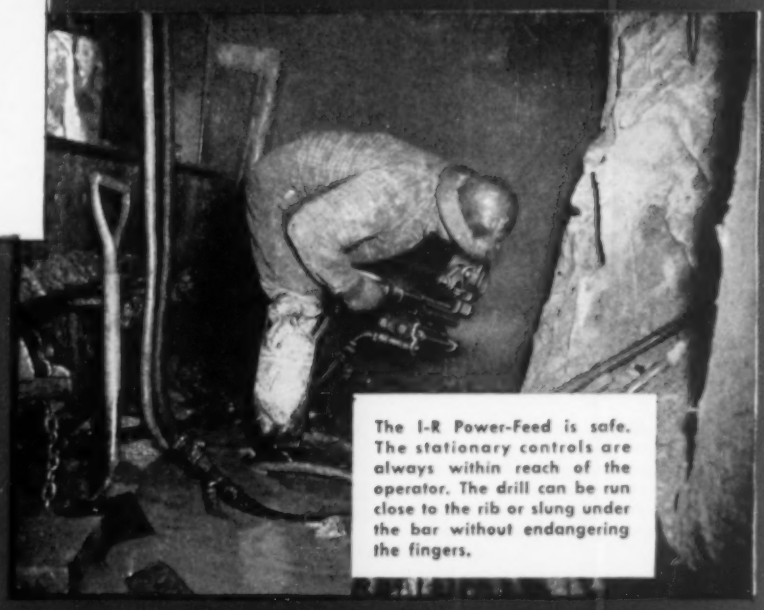
All Ingersoll-Rand drifters are extremely fast drillers, but men using them become even more productive if these powerful and durable machines are equipped with Power-Feeds. The Power-Feed will keep the drills cutting rock a greater percentage of the time. Steel changes are made much more rapidly, the drill operator is less fatigued at the end of the shift, and there is no letdown in his rate of drilling. These are all factors leading to greater footage per man-shift.



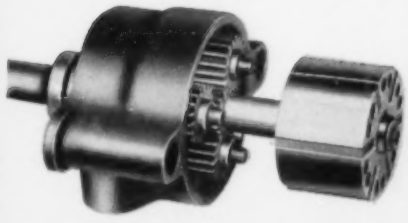
The I-R feed motor is attached to the end of the shell. In this position, it does not receive any direct shock from the running drill. Its location provides safety. Only one size of Power-Feed is used on all I-R Drifters. There is no need to stock different sizes of repair parts.



The rotor is the only major moving part of the I-R Power-Feed motor. This motor, therefore, requires very little attention beyond the occasional replacement of a vane.



The I-R Power-Feed is safe. The stationary controls are always within reach of the operator. The drill can be run close to the rib or slung under the bar without endangering the fingers.



Roller bearings are used on the driveshaft and a simple method of gearing provides a dependable feeding action. Forty different positions on the feed throttle permit the proper adjustment for any kind of rock condition.

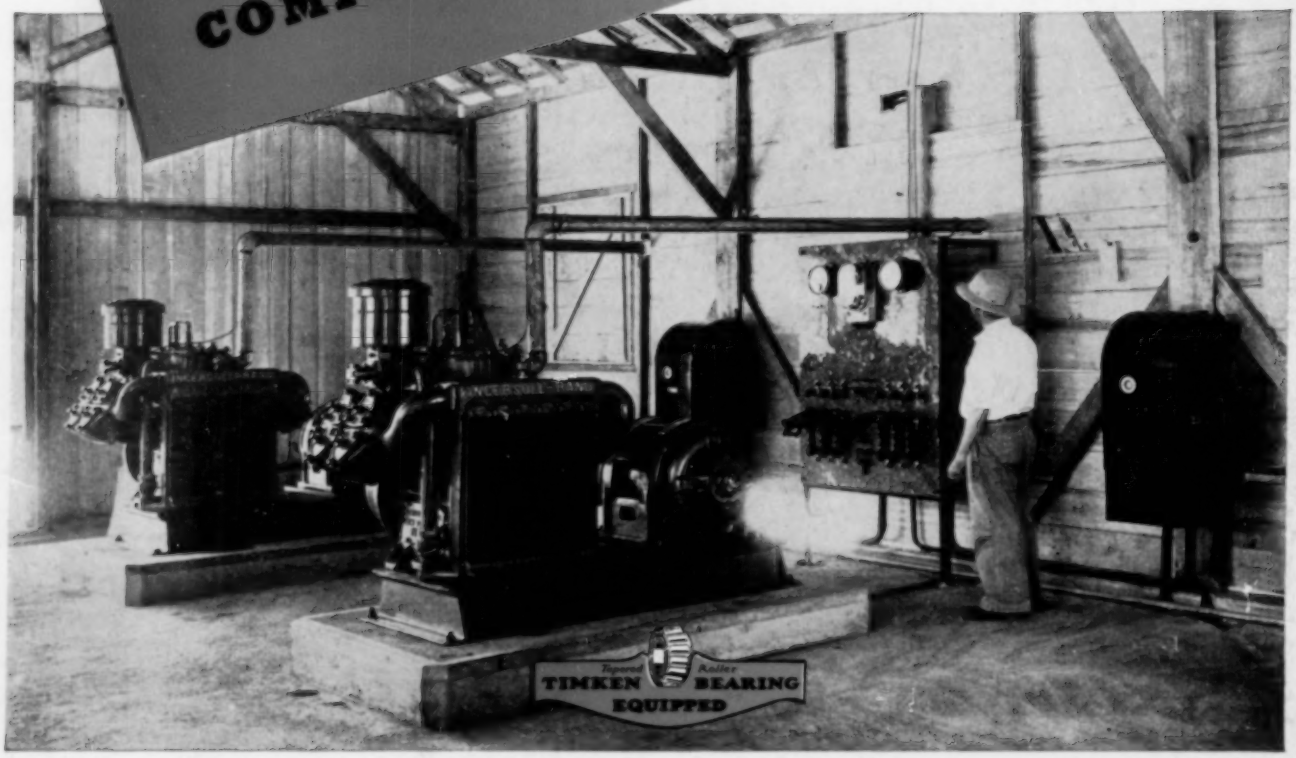
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

S-433

COMPRESSORS • AIR ENGINES • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

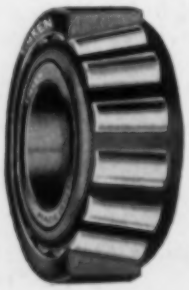
TIMKEN BEARING EQUIPPED COMPRESSORS *at Rio de Janeiro*



The two Ingersoll-Rand Model 50B Type 40 Compressors shown in the photograph, were installed to furnish air for quarry and general excavation work in connection with the building of the new National Steel Plant, Volta Redonda, Rio de Janeiro. They are equipped with Timken Tapered Roller Bearings on the main crankshafts.

Ingersoll-Rand Company has been using Timken Bearings on various models of compressors for years and knows they can be relied upon to furnish anti-friction advantages in full, including smooth operation; prevention of wear on crankshafts; protection against radial, thrust and combined loads; and maintenance of crankshaft alignment under all conditions.

When buying an anti-frictionized compressor of any type specify "Timken Bearing Equipped" and be sure of getting anti-friction performance at its best. The Timken Roller Bearing Company, Canton 6, Ohio.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS